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(54) A photosensitive silver halide emulsion with (100) tabular grains

(57) A photosensitive emulsion is disclosed comprising tabular silver halide grains having (100) major faces and an aspect ratio of 2 or more, wherein at least 20 % of the projected area of all grains is provided by said tabular grains, characterized in that said grains are comprising at least one dislocation of a mixed type (screw component and edge component). In a further embodiment said dislocation(s) is(are) characterized by a ⟨110⟩ Burgers vector.

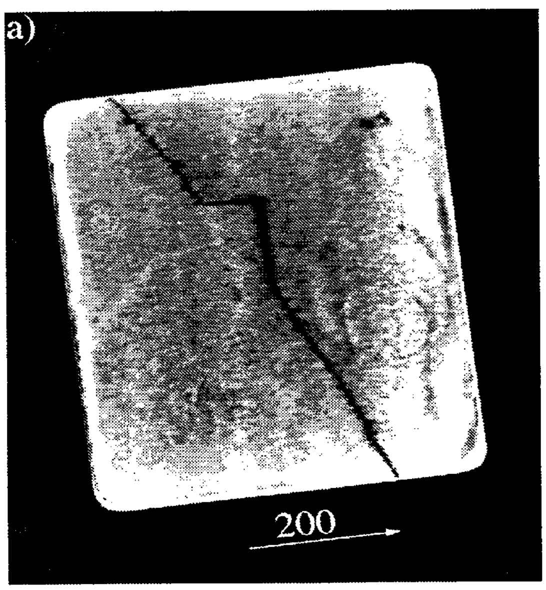

FIG. 6A

EP 0 932 077 A2

Description

FIELD OF THE INVENTION

[0001] The present invention relates with a tabular emulsion showing an increased sensitivity and covering power. More specifically the invention is related to a homogeneous silver halide emulsion having (100) tabular grains.

BACKGROUND OF THE INVENTION

[0002] The use of tabular grains in photographic industry is becoming more important for many applications. The most important reason why tabular grains are so preferred nowadays is their inherent property of having an increased ratio of surface area to volume ratio. This ratio has a positive influence on the effectiveness of the spectral sensitization which is caused by a better interaction between spectral sensitizer and silver halide grain. Moreover an enhanced spectral sensitivity resulting therefrom is deteriorated to a lesser extent as desensitization by an increased concentration of the spectral sensitizer is not occurring as significantly as with other types of grains. Another desired effect resulting from the shape of the tabular grain is its increased covering power which is observed after processing and which is a result of an increased light absorption. As a consequence the possibility of coating thinner emulsion layers with lower amounts of silver is offered.

[0003] The type of tabular grain that is used can also play an important role in a lot of different applications. If silver bromide crystals are grown at a high bromide ion excess with respect to the presence of silver ions, tabular grains are easily formed. The anisotropic growth habit that is experienced is due to the presence of usually two or three twin planes parallel to a (111) plane as published by Berriman et al. in Nature, Vol.180(1957), p.293 and J.Hamilton et al. in J.Appl.Phys., Vol.35(1964), p.414. A first model proposed by D.Hamilton et al in J.Appl.Phys., VoL.31(1960), p.1165 assumes that all side faces are composed of (111) planes forming ridges and re-entrant grooves at the twin planes. The re-entrant grooves are sites where the nucleation of a new layer occurs more easily, thus promoting tabular growth.

[0004] In the last decade some investigators suggested that the side faces do not necessarily have to consist entirely of (111) planes. Therefor another model was proposed by G.Boegels et al in Acta Cryst., Vol.A53(1997), p.84, which was based on the assumption that the side faces can be composed of (111) as well as of (100) parts and that the transition between the two occurs at the twin boundaries. The tabular growth is then a consequence of the fact that under these conditions a (100) plane grows faster then a (111) plane. So the (100) part of the side plane grows the fastest and at the twin boundary a substep is created which acts as a source for the growth of the (111) part and the side edge grows as fast as the (100) plane. The top and bottom planes, which still are entirely (111) planes, grow slower and two dimensional growth is induced.

[0005] However the same procedure can not be applied in order to make silver chloride tabular grains because of some problems due to the high ionic charges related therewith. While the (111) planes of silver chloride are not stable under these circumstances in an aqueous environment, even at high chloride concentrations, it is not possible to form stable (111) planes. A solution for this problem has been brought by the addition of a stabilizer which has some negative consequences like sensitivity loss, interference with chemical and spectral sensitization and reproducibility of the emulsion characteristics.

[0006] In order to avoid the use of stabilizers a method was developed wherein tabular crystals having stable (100) surfaces were grown. The first publications on tabular grains bounded by (100) parallel major faces were related with silver iodobromide emulsions. Bogg in US-A 4,063,951 and Mignot in US-A 4,386,156 were the most important publications. In EP-A 0 534 395 Brust et al. disclose the first (100) tabular emulsion grains rich in chloride and a process for preparing them wherein the tabular grain fraction showing (100) major faces is significant. Further improvements and variations on the teachings of the said tabular (100) emulsions rich in chloride have been described in US-A's 5,024,931; 5,264,337; 5,275,930; 5,292,632; 5,310,635; 5,314,798; 5,320,938; 5,356,764; 5,601,967; in WO-Applications 94/22051 and 94/22054 and in EP-A's 0 569 971; 0 584 815; 0 584 644; 0 602 878; 0 616 255; 0 617 317; 0 617 320; 0 617 321; 0 617 325; 0 618 492; 0 618 493; 0 653 659 and 0 653 669.

[0007] A completely different kind of growth mechanism had to be found, because the [111] twinning does not give (100) tabular grains since the (111)faces are not stable. So the presence of defect introducing substeps like e.g. (111) stacking faults, screw or mixed dislocations may cause accelerated growth in certain directions.

[0008] In all the situations described hereinbefore the (100) tabular grains grown with dislocations have some particular advantages. These are for this type of (100) tabular grains, besides the already mentioned factor of the increased ratio of surface area to volume, the presence of stable (100) faces if compared with (111)tabular crystal faces, particularly for silver chloride crystals. Lack for a stabilizer means that no problematic interactions between said stabilizer and a chemical or spectral sensitizer occur. Further the efficiency of anisotropic growth induced by dislocations or twin bounderies is higher than anisotropic growth induced by stacking faults as has been disclosed by Ming et al.,J.Cryst.Growth, Vol.115(1991),p.199.

[0009] Photographic or sensitometric results of the tabular grains can advantageously be influenced by increasing their level of tabularity in order to minimize the number of nontabular grains. This in turn will increase the homogeneity of the emulsion which positively influences photographic characterisitics like e.g. sensitivity, gradation, sharpness, graininess, covering power, etc. The way in which the homogeneity of the tabular emulsion can be increased has already been discussed in several references before as e.g. in Research Disclosure No.39410, p. 83-89, publ. January 1997, in J.Imag.Sci.Technol., Vol. 41(4), 1997, p. 413-415 and in IS&T's 49th Annual Conference,p.35-37.

[0010] There seems to be a globally corresponding insight between the various investigating groups in this field in that the (100) tabular silver halide grains should be formed via an anisotropic growth mechanism. Discussions with respect to this subject indicate that the most important reason why anisotropic tabular crystal growth effectively occurs is the actual presence and the type of dislocation present in the grain. This has been described by T.Oyamada et al in US-P 5,665,530 wherein is stated that the anisotropic growth which is responsible for the formation of (100) tabular silver halide grains is caused by the presence of a dislocation that is thought to be presumably a screw dislocation. The patent itself describes never the real status of the dislocation responsible for the anisotropic growth. However the presentation of Oyamada at the 1997 International Symposium on Silver Halide Imaging held in Vancouver (Proceedings, p.2-7) is pointing definitly to the screw dislocation as cause for the anisotropic growth for the cited class of crystals.

[0011] As there has always been interest in (100) tabular silver halide emulsion crystals providing a further increase in tabularity, any measure taken in order to get such emulsions is welcome.

[0012] For further reading of the contents of the present invention it has to be recommended to be aware of the following definitions:

- definition of the Miller indices of crystal planes (klm) and crystal directions [a b c] as described e.g. in "Introduction to dislocations", Derek Hull, Pergamon Press Ltd., (1965), p. 1-4.
- a dislocation is a line defect in the crystal; wherein the deviation that is formed in a crystal lattice is characterized by the Burgers vector.
- the Burgers Circuit is any atom to atom path around the dislocation taken in a crystal containing a dislocation which forms a closed loop.
- the Burgers vector is the closure failure that gives the connection between the end and the starting point of the same Burgers circuit made in a perfect crystal.

For screw dislocations the said closure failure leads to a vector parallel to the dislocation line; whereas for an edge dislocation the Burgers vector characterizing the closure failure is perpendicular to the said dislocation line. Any other angle between the Burgers vector and a dislocation line leads to a mixed dislocation thus it consists of a screw component and an edge component. More detailed information upon this subject can be found in "Introduction to dislocations", Derek Hull, Pergamon Press Ltd., (1965), p. 16-21.

OBJECTS OF THE INVENTION

[0013] It is therefore a first object of the present invention to provide a silver halide emulsion comprising new (100) tabular silver halide grains showing increased tabularity.

[0014] It is a further object of the present invention to provide a silver halide emulsion wherein the said new (100) tabular grains have an improved homogeneity.

[0015] Further objects and advantages of the invention will become apparent from the description hereinafter.

SUMMARY OF THE INVENTION

[0016] The above mentioned objects are realized by a photosensitive emulsion comprising tabular silver halide grains having (100) major faces and an aspect ratio of 2 or more, wherein at least 20 % of the projected area of all grains is provided by said tabular grains, characterized in that said grains are comprising at least one dislocation of the mixed type (screw component and edge component). In a further embodiment said dislocation(s) is (are) characterized by a 〈110〉 Burgers vector.

[0017] Preferred embodiments of the invention are disclosed in the dependent claims.

BRIEF DESCRIPTION OF THE PHOTOGRAPHS.

[0018]

Figure 1 a): electron microscopical image of a grain of a comparitive emulsion which comprises minimum one screw dislocation, marked by the white arrow;

Figure 1 b) and 1 c): electron microscopical image of the same grain as in Fig. 1 a) under conditions wherein a dislocation characterized by a 〈100〉 Burgers vector becomes extinct.

Figure 2 a): electron microscopical image of an emulsion grain which contains dislocations, marked by the white arrows, as disclosed in the present invention and which are of the mixed type.

Figure 2 b) and 2 c): electron microscopical image of the same grain under conditions where a dislocation characterized by a 〈110〉 Burgers vector becomes extinct.

Figure 3 a) gives an illustration of a comparative example prepared under the same conditions as an inventive emulsion, represented in Figure 3 b) with the difference that in the <u>comparative example no</u>

iodide ions were added after the nucleation step, whereas in the preparation of the inventive emulsion iodide ions were added after the nucleation. As a result a serious increase of the number of (100) tabular silver halide grains is observed for the inventive emulsion (see detailed description).

Figure 4 gives a silver bromide (100) tabular crystal showing a mixed dislocation with an a/2⟨110⟩ Burgers vector; a) showing the direction of the dislocation, b) and c) showing two extinction conditions allowing to determine the Burgers vector. The used diffraction vectors are indicated by the white arrows.

Figure 5 gives a collection of silver bromide (100) tabular crystals with mixed dislocations, that do not start from the corner of the crystal.

Figure 6. represents a silver chloride tabular crystal showing a mixed dislocation with an a/2⟨110⟩ Burgers vector; a) showing the direction of the dislocation, b) and c) showing two extinction conditions allowing to determine the Burgers vector. The used diffraction vectors are indicated by the white arrows.

Figure 7 gives a collection of silver chloride (100) tabular crystals with mixed dislocations, that do not start from the corner of the crystal.

DETAILED DESCRIPTION OF THE INVENTION

[0019] While the present invention will hereinafter be described in connection with preferred embodiments thereof, it will be understood that it is not intended to limit the invention to those embodiments. On the contrary, it is intended to cover all alternatives, modifications, and equivalents as may be included within the spirit and scope of the invention as defined by the appending claims.

[0020] The photosensitive emulsion of the present invention comprises tabular silver halide grains having (100) major faces and having at least one dislocation of mixed type, i.a. consisting of a screw and an edge component.

[0021] As a consequence (100) tabular silver halide emulsion grains or crystals are characterized by said dislocation(s) of mixed type as a new element which has been introduced in the crystal lattice and which activates anisotropic growth, more than has ever been described before.

[0022] The silver halide grains of the present invention are prepared by substantially performing at least two distinct precipitation steps in an aqueous medium into a reaction vessel, followed by desalting by means of flocculation and washing or by means of ultrafiltration, said emulsion comprising a colloidally stabilizing binder and (100) tabular silver halide grains, wherein at least 20 % by number of all grains is provided by said tabular grains, and wherein said tabular grains exhibit an average aspect ratio of at least 2, distinct precipitation steps being a nucleation step and one growth step, said method further being characterized by introducing after ending the said nucleation step one or more crystal dislocation(s) onto nuclei formed in the said nucleation step in order to provide anisotropic growth of the said nuclei into (100) tabular grains. The introduction of said dislocations which are of the mixed type, i.e. consisting of a screw and an edge component, can be performed by the addition of other ions to the nuclei as will be described hereinafter. The number of dislocation lines is less than 5 and preferably less than three and most preferably one. Finally tabular grains without any dislocation line can also be present which is mainly experienced in the bromide containing emulsions.

However in a more prefered silver halide emulsion of the present invention the amount of the aforementioned tabular grains is at least 30 % number and most prefered 50 %. In the case of emulsions containing an increasing amount of bromide the number of crystals free of dislocations increases which is probably caused by the mobility of the dislocations in the silver bromide lattice which is higher than in the chloride lattice. 50 % or more of said tabular grains can be free of dislocations.

[0023] Another method by which (100) tabular silver halide grains of the present invention are prepared has been described in the EP-Application No. 97.203311.2, filed October 24, 1997, which is incorporated herein by reference and wherein a method has been claimed for preparing a light-sensitive silver halide photographic emulsion comprising performing at least three distinct precipitation steps in an aqueous medium into a reaction vessel, followed by desalting by means of flocculation and washing or by means of ultrafiltration, said emulsion comprising a colloidally stabilizing binder and (100) tabular silver halide grains containing at least 50 mole % of silver chloride, wherein at least 60 % by number of all grains is provided by said tabular grains, and wherein said tabular grains exhibit an average aspect ratio of at least 2, an average thickness of at most 0.25 μm with a variation coefficient of at most 0.25, and an average equivalent circular crystal diameter of 0.3 μm or more with a variation coefficient of at most 0.20; said three distinct precipitation steps being a nucleation step and two growth steps, said method being further characterized by introducing after ending the said nucleation step one or more crystal dislocation(s) onto nuclei formed in the said nucleation step in order to provide anisotropic growth of the said nuclei into (100) tabular grains, wherein introducing said crystal dislocation(s) is performed within a time taking no longer than the time required to perform a first physical ripening step after the nucleation step in order to get a number of dislocation lines of less than 5, in one and the same crystallographic plane, and wherein said physical ripening step between introducing said dislocation(s) and growing the nuclei having said dislocation(s) in a first growth step proceeds within a time interval from 2 to 10 minutes.

[0024] The said methods as described hereinbefore and modifications thereon apparent to one skilled in the art are in order to prepare (100) tabular silver halide emulsions according to the present invention, wherein said emulsions are composed of a binder and silver halide crystals containing chloride and bromide apart or mixed, optionally together with iodide. This means that silver halide emulsions according to the present invention are composed of silver chloride, silver bromide, silver chlorobromide, optionally (and even preferably) together with (a small amount of) silver iodide.

[0025] In the type of silver halide emulsion grains of the present invention mainly one type of dislocation occurs that has a Burgers vector which is always of the a/2⟨110⟩ type. The principal direction depends on the halide composition and is for the emulsions containing chloride mainly situated between [210] and [510] but the [410] direction is preferred. The direction present in a low amount in the grains is the [100] direction. The silver halide emulsions of the present invention comprising bromide is containing dislocations that can have almost all possible directions which are always situated in a plane paralel to the (001) crystal surface layer.

[0026] So all dislocations have a mixed character which is neither parallel nor perpendicular to the Burgers vector. The direction of the dislocations in these crystals rarely changes and is sometimes restricted to a short segment.

[0027] There is one configuration of dislocations which can occur in silver halide grains and which has a rectangular shape (seen from a top view). The ratio between the sides L and l of the rectangle seen from the said top view (L and l being the largest and the smallest side of the rectangle respectively) is approximately from 10:1 up to 1:1 and more preferably from 3:1 up to 1:1. In one of the corners there is sometimes a small dislocation loop from which one dislocation starts in one or two directions. Here again it is found that the bromide containing silver halide crystals of the present invention can have almost all possible directions which however are situated in a plane paralel to the (001) crystal surface layer.

[0028] If more dislocations are formed, which all lie in a (001) plane, the position of the point where the dislocations intersect, can shift away from the corner of the crystal to the centre (see Figures 5 and 7).

[0029] The dislocations are formed after the first nucleation step when growth continues. Silver halide grains taken immediately after the nucleation step are very small and do not show a defect contrast. In crystals taken from the emulsion during the first growth step some contrast caused by dislocations becomes visible. Once the dislocations are formed, important changes don't occur anymore, except for the tabular growth of the crystals. The direction of the dislocations mostly does not change to a remarkable extent except for the bromide containing silver halide crystals where the dislocation lines which are all situated in a plane paralel to the (001) crystal surface have no specific directions.

[0030] The dislocations of the mixed type, characterizing the emulsions of the present invention, are introduced during preparation by addition, after the nucleation step, of (organic or inorganic) compounds (e.g. organic compounds providing adsorption; ions providing supersaturation, ionic transition metal complexes having organic and/or inorganic ligands and the like), thereby causing lattice strains due to the introduction of ingredients, strange to the crystal lattice.
For instance in silver bromide crystals dislocations of the mixed type can be incorporated by starting with the formation of a silver chloride nucleus followed by a growth step with bromide. Silver bromide with dislocations of the present invention can also be formed by first precipitating a small amount of iodide on said silver chloride nuclei followed by the same silver bromide precipitation step as just described hereinbefore. In the same way dislocations of a mixed type of the present invention can be formed in silver chloride crystal by adding a small amount of iodide after the formation of a silver chloride nucleus. In the case of silver bromide and silver chloride as well, the iodide ions are provided by organic or inorganic compounds providing said ions which induce lattice strains because of their larger radius but bromide ions can also be used as a means to form the dislocations of a mixed type in the chloride lattice. It is important to create the desired conditions in the reaction vessel with respect of degree of supersaturation, amount and introduction rate of the compounds which appear to be 'strange to crystal lattice' of the silver halide crystals precipitated in order to get a silver halide emulsion according to the present invention.

[0031] Sometimes a dislocation with a Burgers vector of a/2⟨110⟩ can dissociate into two partial dislocations of the a/6⟨112⟩ type as is described by D.Hull (reference mentioned hereinbefore). Such a partial dislocation have a Burgers vector that is not a lattice vector. After dissociation the partial dislocations will be separated by a stacking fault. The chance that such a dislocation of the present invention dissociates, depends on the energy necessary to form a stacking fault. In the case of silver halides this energy is relatively high which means that the formation of partial dislocations is unlikely. However they stay very close together in the case they are formed.

[0032] As an illustration an emulsion was grown as comparative example (see Figure 3 a) under the same conditions as for the inventive emulsion (see Figure 3 b) but without addition of iodide after the nucleation step. As a result a serious decrease of the number of (100) tabular grains was observed and further the defect structure was similar to that of the silver halide grains that were free from iodide. The grains taken from the emulsion at the end of the growth process now contain screw dislocations characterized by a [100] Burgers vector which are thus mostly parallel to [100] directions instead of to [410] directions.

[0033] The invention as described hereinbefore has been illustrated in the following example which is representative for a chloroiodide emulsion. However it is clear that the invention is not limited thereto and that many variations are possible as is demonstrated by the various photographs in the figures 4 till 7 as can be understood by someone skilled in the art.

Example.

Preparation of <u>Emulsion A (comparative emulsion)</u>

[0034] 1160 ml of a dispersion medium (C) containing 156 g of gelatin containing 800 ppm of methionine and containing less than 40 ppm of calcium ions was provided in a stirred reaction vessel. The pCl was adjusted with sodium chloride to a value of 2.0; pH was adjusted to a value of 5.7 and the reaction vessel was held at a constant temperature of 35°C.

[0035] While vigourously stirring this solution, 76 ml of a 2.94 molar solution of silver nitrate and 76 ml of a 2.94 molar solution of sodium chloride were added simultaneously at a rate of 80 ml per minute by double jet precipitation.

[0036] Into the said reaction vessel 1250 ml of a solution containing 600 mg of sodium chloride was poured and the temperature of the mixture was raised to 50°C during the next 5 minutes.

[0037] 58 ml of a 2.94 molar solution of a silver nitrate solution and 58 ml of a 2.94 molar solution of a sodium chloride were added simultaneously at a rate of 8 ml per minute each, while maintaining the pCl value at 2.2 and the temperature at 50°C.

[0038] 119 ml of a 2.94 molar solution of a silver nitrate solution and 119 ml of a 2.94 molar solution of a sodium chloride were further added simultaneously at a linearly increasing addition rate for both starting from 8 ml up to 12 ml per minute while the pCl value decreased from 2.2 to 1.8 and while the temperature was raised from 50°C to 65°C.

[0039] The temperature of the mixture in the reaction vessel was further held at a value of 65°C for 20 minutes.

[0040] 477 ml of a 2.94 molar solution of a silver nitrate solution and 477 ml of a 2.94 molar solution of a sodium chloride were further added simultaneously at a linearly increasing addition rate for both starting from 8.8 ml up to 28 ml per minute while maintaining the pCl value at 1.8 at 65°C.

[0041] The temperature of the mixture in the reaction vessel was further held at a value of 65°C for 30 minutes.

[0042] Into the mixture obtained in the reaction vessel 80 ml of a solution containing 2 g of potassium iodide were poured for a second iodide conversion step.

[0043] By double jet precipitation 70 ml of a solution of 2.94 molar of silver nitrate and 70 ml of a solution containing 2.94 molar of sodium chloride were added simultaneously at a rate of 8 ml per minute while maintaining the pCl value at 1.8 and the temperature at 65°C.

[0044] The photographs made from the grains of this emulsion are represented in Figure 1 where the characteric dislocations as claimed and as present in the inventive example described hereinafter are clearly lacking.

Preparation of <u>Emulsion B (inventive emulsion)</u>

[0045] 1160 ml of a dispersion medium (C) containing 156 g of gelatin containing 800 ppm of methionine and containing less than 40 ppm of calcium ions was provided in a stirred reaction vessel. The pCl was adjusted with sodium chloride to a value of 2.0; pH was adjusted to a value of 5.7 and the reaction vessel was held at a constant temperature of 35°C.

[0046] While vigourously stirring this solution, 76 ml of a 2.94 molar solution of silver nitrate and 76 ml of a 2.94 molar solution of sodium chloride were added simultaneously at a rate of 80 ml per minute by double jet precipitation.

[0047] Into the said reaction vessel 1250 ml of a solution containing 456 mg of potassium iodide and 600 mg of sodium chloride was poured (for the first iodide conversion step) and the temperature of the mixture was raised to 50°C during the next 5 minutes.

[0048] 58 ml of a 2.94 molar solution of a silver nitrate solution and 58 ml of a 2.94 molar solution of a sodium chloride were added simultaneously at a rate of 8 ml per minute each, while maintaining the pCl value at 2.2 and the temperature at 50°C.

[0049] 119 ml of a 2.94 molar solution of a silver nitrate solution and 119 ml of a 2.94 molar solution of a sodium chloride were further added simultaneously at a linearly increasing addition rate for both starting from 8 ml up to 12 ml per minute while the pCl value decreased from 2.2 to 1.8 and while the temperature was raised from 50°C to 65°C.

[0050] The temperature of the mixture in the reaction vessel was further held at a value of 65°C for 20 minutes.

[0051] 477 ml of a 2.94 molar solution of a silver nitrate solution and 477 ml of a 2.94 molar solution of a sodium chloride were further added simultaneously at a linearly increasing addition rate for both starting from 8.8 ml up to 28 ml per minute while maintaining the pCl value at 1.8 at 65°C.

[0052] The temperature of the mixture in the reaction vessel was further held at a value of 65°C for 30 minutes.

[0053] Into the mixture obtained in the reaction vessel 80 ml of a solution containing 2 g of potassium iodide were poured for a second iodide conversion step.

[0054] By double jet precipitation 70 ml of a solution of 2.94 molar of silver nitrate and 70 ml of a solution containing 2.94 molar of sodium chloride were added simultaneously at a rate of 8 ml per minute while maintaining the pCl value at 1.8 and the temperature at 65°C.

[0055] The precipitation procedure for this "inventive emulsion B" is exactly the same as for the preparation of the 'comparative emulsion A', except for the addition of iodide after the nucleation step.

Procentual amounts of tabular grains in the comparative Example and in the inventive Example were less than 48 % and more than 75 % respectively.

[0056] The photographs made from grains of this emulsion are represented in Figure 2 where the characteric dislocations of the mixed type as claimed and as described in the detailed description of the present invention are clearly shown.

The photographs in the Figures 1 (comparative) and 2 (inventive) thus clearly show the difference in grain structure with respect to the dislocations present in the (100) tabular silver halide grains.

[0057] Figure 4 gives a silver bromide (100) tabular crystal showing a mixed dislocation with an a/2⟨110⟩ Burgers vector. In Figure 4 a) the direction of the dislocation is shown while the Figures 4 b) and 4 c) are showing two extinction conditions allowing to determine the Burgers vector. The used diffraction vectors are indicated by the white arrows.

[0058] Figure 5 gives a series of photographs of silver bromide (100) tabular crystals with mixed dislocations, that do not start from the corner of the crystal.

[0059] Figure 6. represents a silver chloride tabular crystal showing a mixed dislocation with an a/2⟨110⟩ Burgers vector. In Figure 6 a) the direction of the dislocation is shown, while the Figures 6 b) and 6 c) show two extinction conditions allowing to determine the Burgers vector. The used diffraction vectors are indicated by the white arrows as in Figure 4.

[0060] Figure 7 gives a collection of photographs of silver chloride (100) tabular crystals with mixed dislocations, that do not start from the corner of the crystal.

Claims

1. A photosensitive emulsion comprising tabular silver halide grains having (100) major faces and an aspect ratio of 2 or more, wherein at least 20 % of the projected area of all grains is provided by said tabular grains, characterized in that said grains are comprising at least one dislocation of a mixed type.

2. Photosensitive emulsion according to claim 1, wherein the said dislocation(s) is(are) characterized by a ⟨110⟩ Burgers vector.

3. Photosensitive emulsion according to claim 1 or 2, wherein said silver halide is composed of silver chloride, silver bromide, silver chlorobromide, silver chloroiodide, silver bromoiodide or silver chlorobromoiodide.

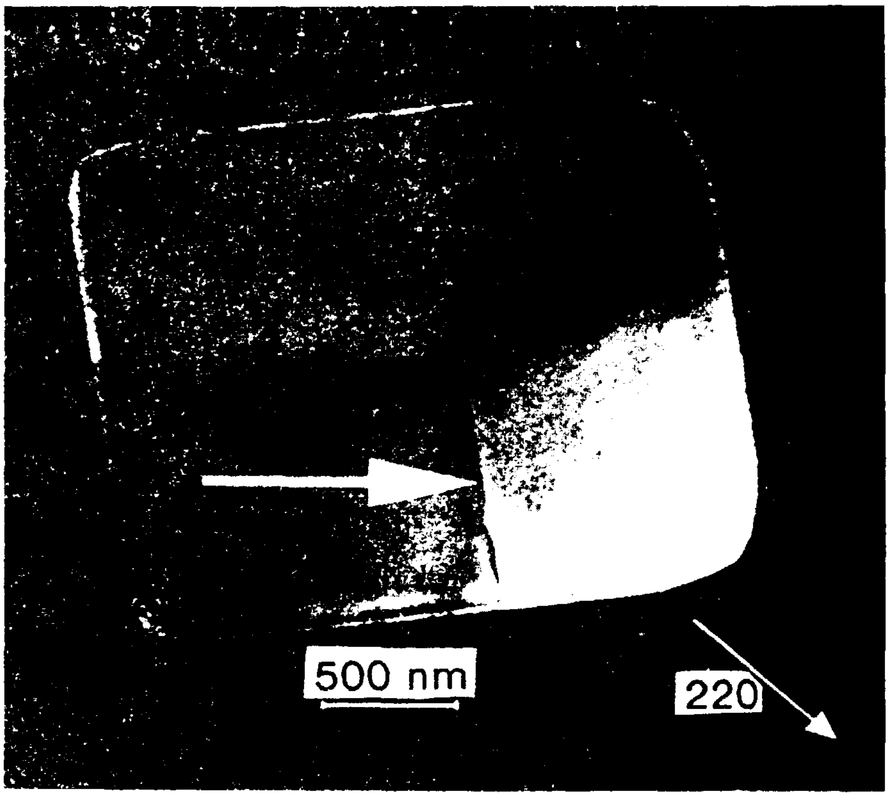

FIG. 1A

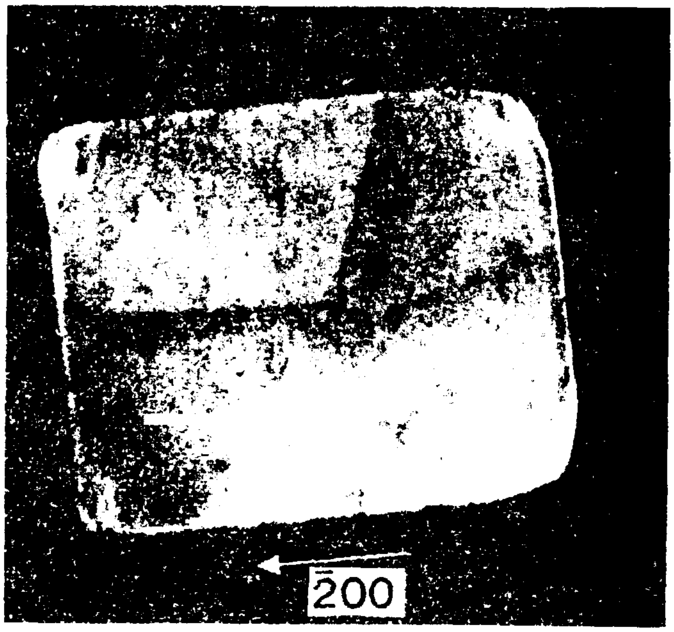

FIG. 1B

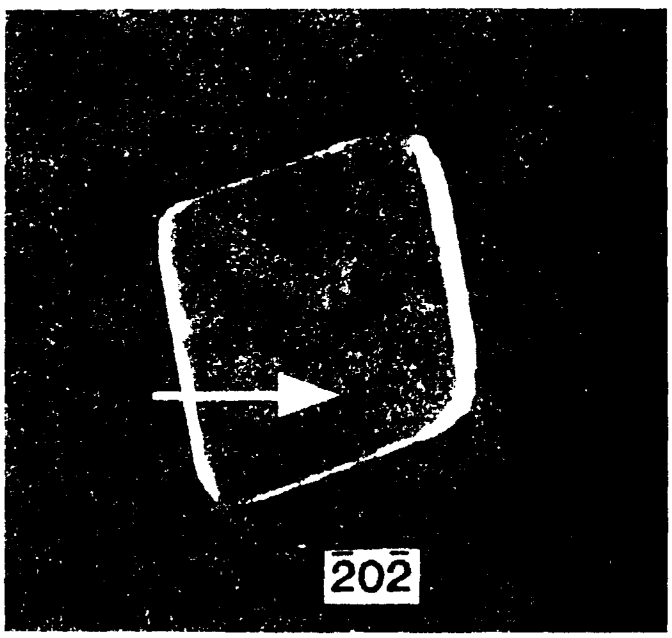

FIG. 1C

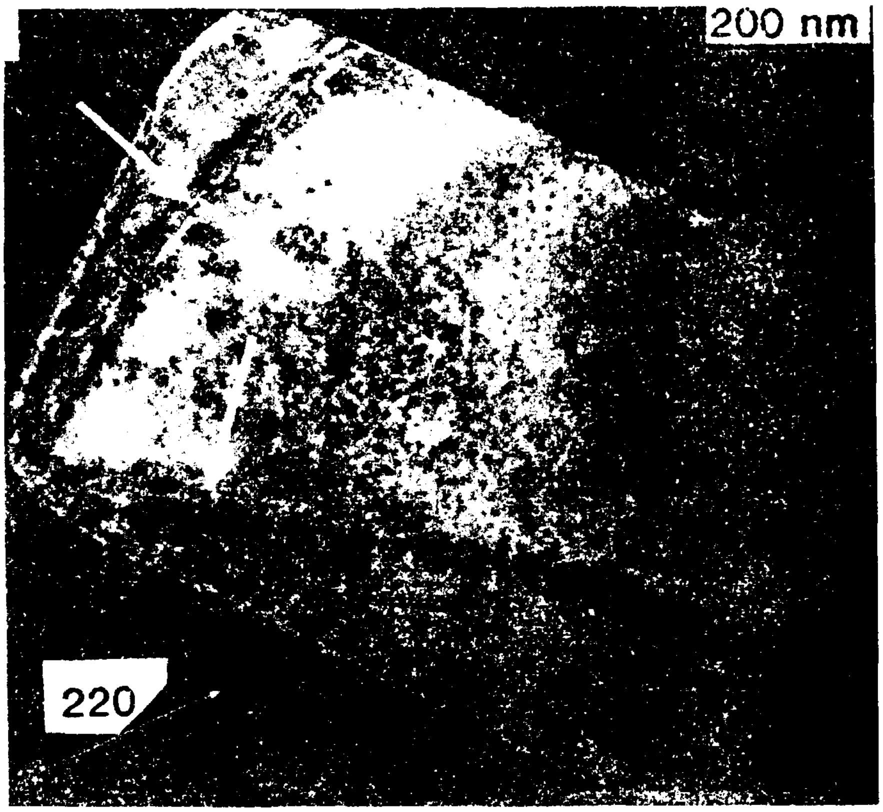

FIG.2A

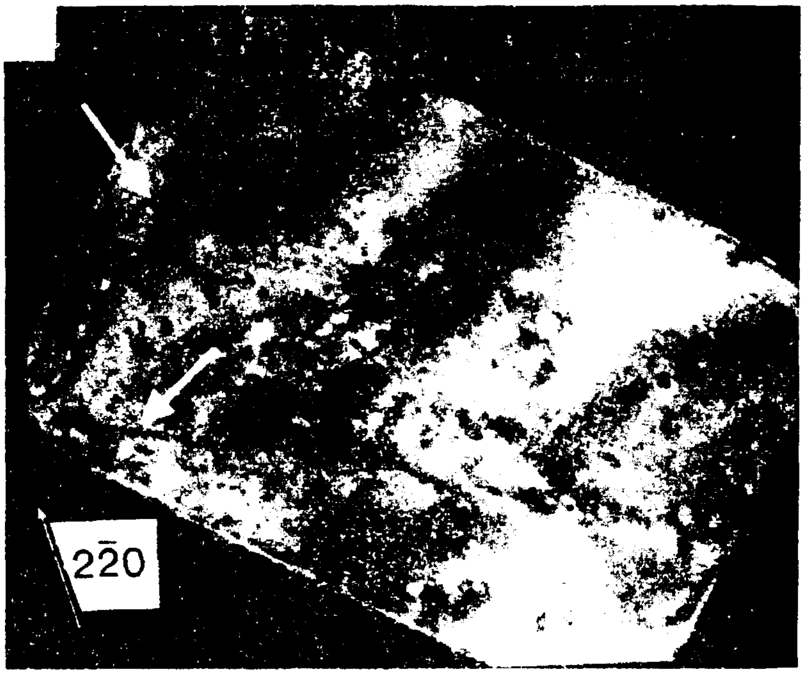

FIG.2B

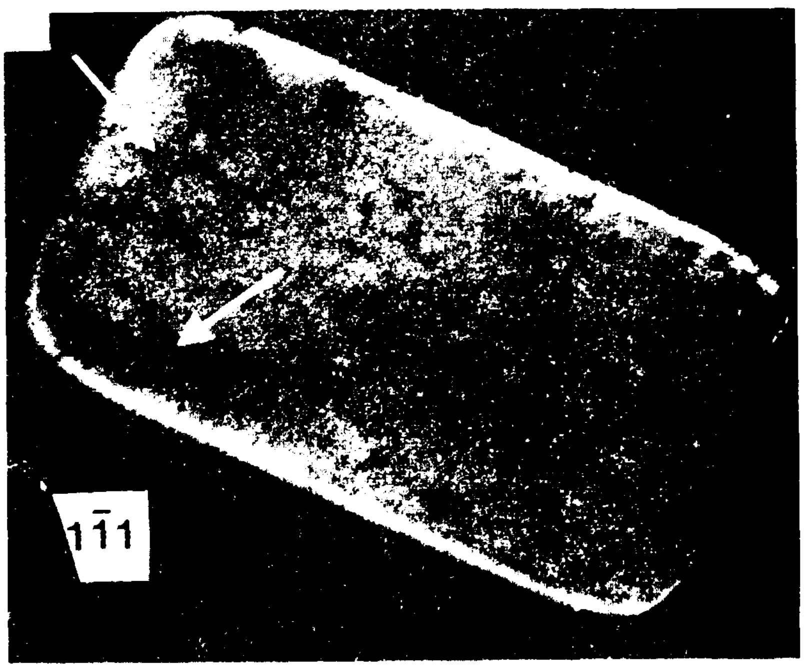

FIG.2C

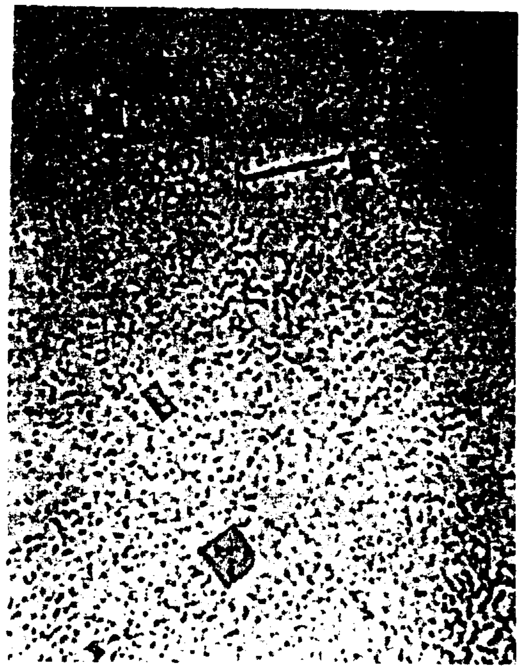

FIG.3A

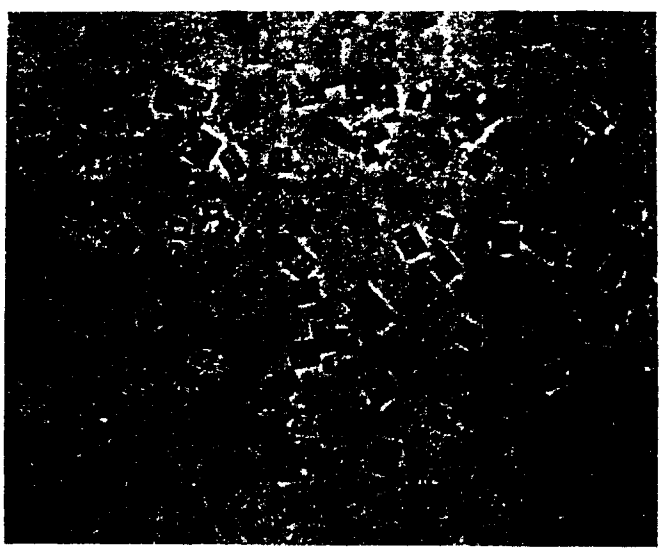

FIG.3B

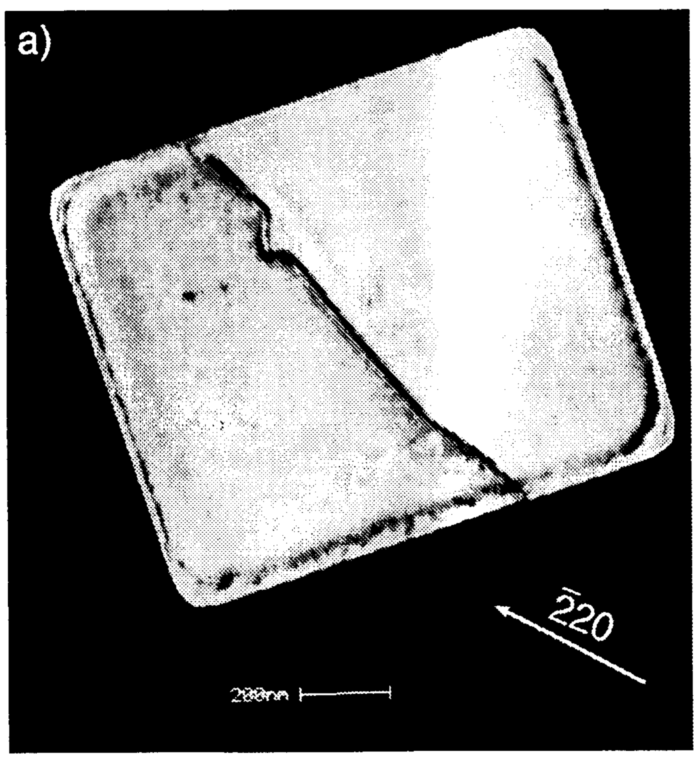

FIG. 4A

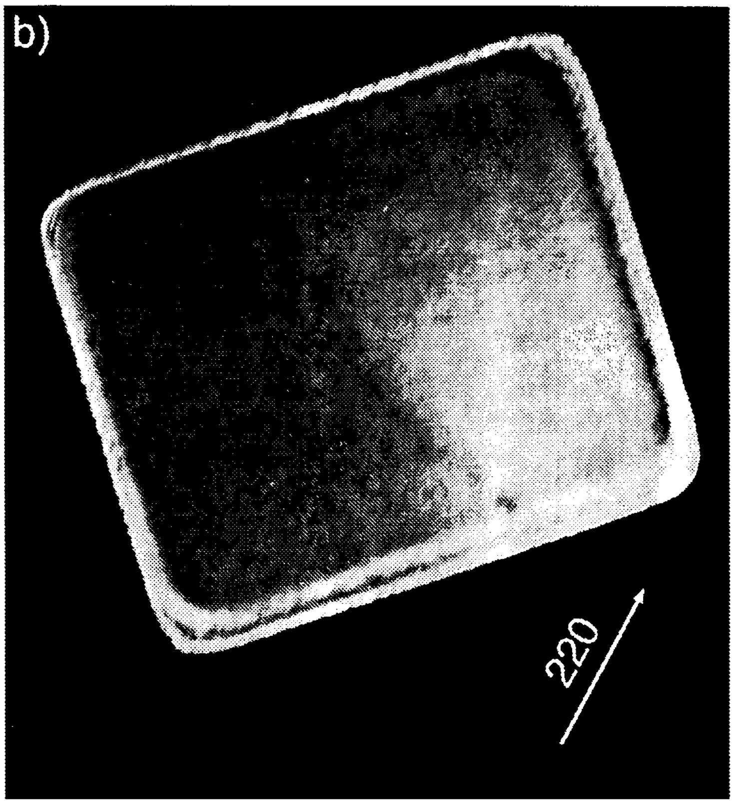

FIG. 4B and FIG. 4C

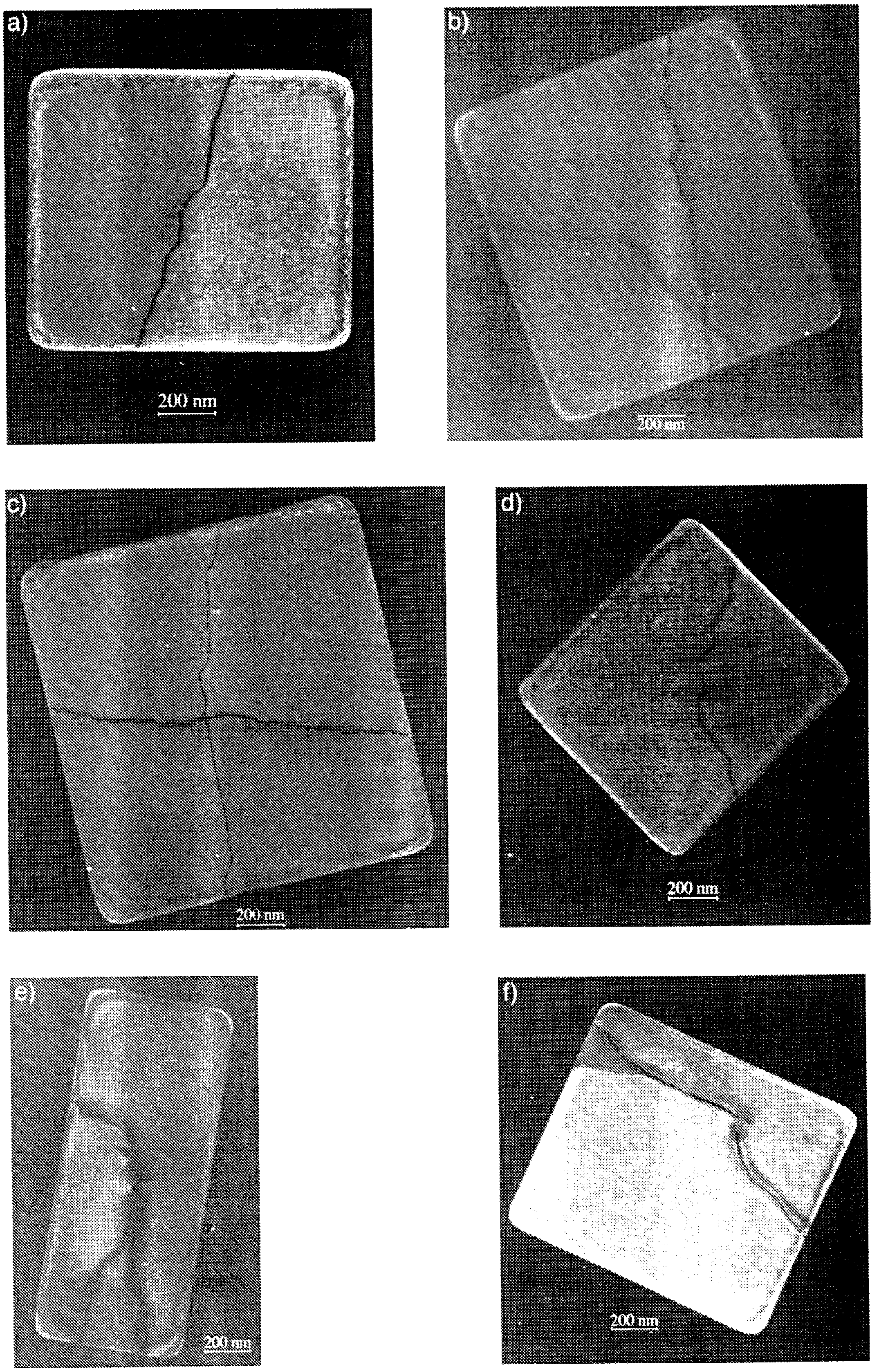

FIG. 5

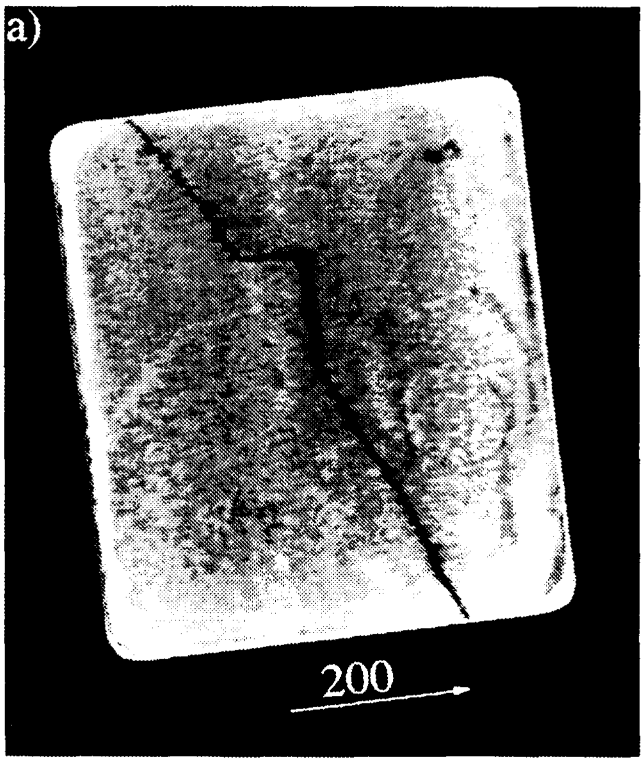

FIG. 6A

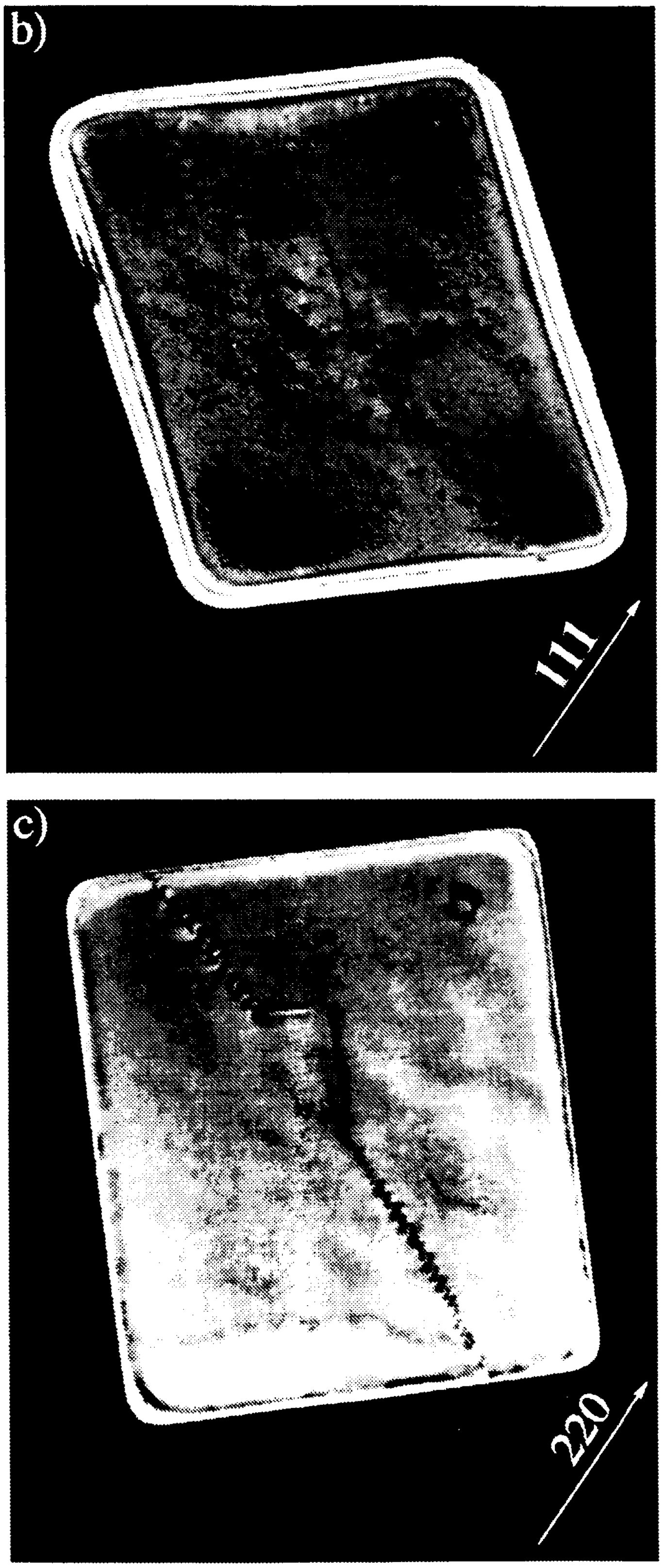

FIG. 6B and FIG. 6C

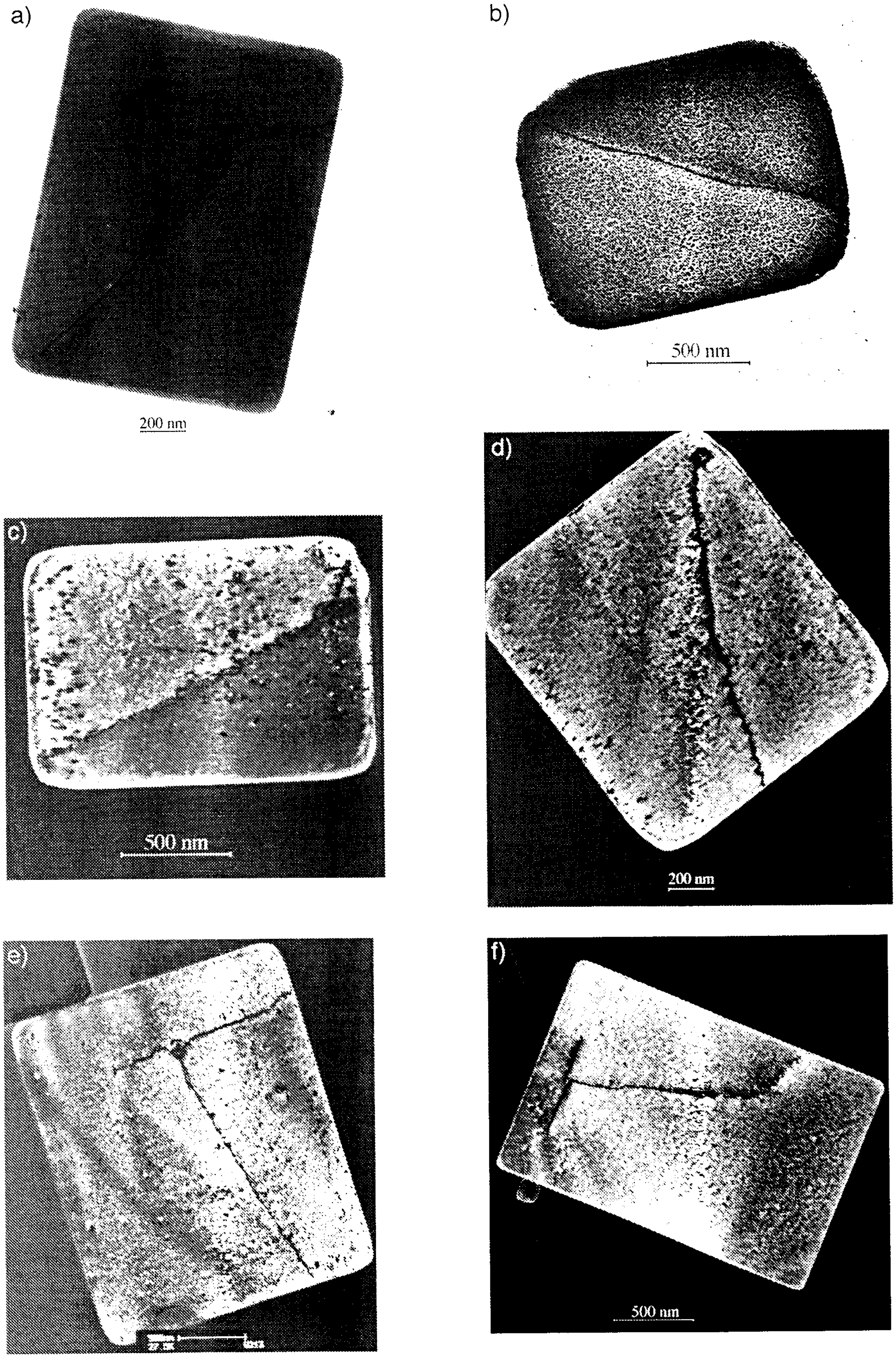

FIG. 7