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Growth of CsI(Tl) Scintillation Film

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Keywords: deposition of thin layers, crystalline structure, relation between structure and physical properties

CsI(Tl) is widely used as scintillation material for the high energy particles and ionizing radiation detectors. In the last decade imaging devices with high spatial resolution based on CsI(Tl) thin layers were developed due to the ability of CsI(Tl) film to grow in columnar morphology. This reduces the lateral light spread and promotes the directional light passing due to the total internal reflection on column boundaries.

CsI(Tl) films of 5-200 μm thickness were obtained by physical vapour deposition technique onto the (100) cleavage planes of LiF single crystal used as orienting substrate and onto the amorphous glass substrates. In both cases columnar morphology of films was observed. Vacuum deposition of CsI(Tl) onto the orienting LiF substrate at appropriate conditions leads to columnar morphology of the grown layer and single crystalline structure of blocks in two orientations, (110) and (112) (the halfwidth of rocking curves was from 8 to 20 arc min for (110) orientation and from 5 to 23 arc min for (112)), that are not coincident with (100) orientation of substrate. This may be the result of great lattice misfit and weak counteraction between the layer and substrate that provides the Volmer-Weber condensation mode and epitaxial growth according to coincident nodes mechanism.

Columnar CsI(Tl) films demonstrate increased scintillation efficiency comparing with the standard CsI(Tl) single crystalline α -detector at thicknesses more than 10 mkm.

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Atomic structure of fluorapatite (100) water interface: A Grazing Incidence X-ray Diffraction (GIXRD) study

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Keywords: fluorapatite (100) surface, water monolayer, GIXRD, crystal truncation rods (CTR)

In recent years, studies of the apatite surface structure and water interface have gained importance. Various experimental as well as theoretical methods have been widely performed to understand apatite - water interface [1, 2, and 3]. Here we present atomic structure of (100) fluorapatite-water interface investigated by surface diffraction (GIXRD) in humid ambient (r.h. \sim 75%). Measurement of specular and non-specular crystal truncation rods (CTR) provided information about the surface structure of mineral and sites of water adsorption on atomic scale. In humid ambient, a laterally ordered monolayer of water is formed at about 1.8 (\pm 0.1) \AA above the relaxed fluorapatite surface. Shifts for all atoms were determined in presence of water molecules. Four water molecules per unit cell related by symmetry of the underlying unit cell order periodically on the surface with Ca-O distances 2.25 \AA and 2.28 \AA providing a charge neutral surface. Relaxation in layers found to decrease with increasing depth which reaches to original bulk values in about 5th layer (\sim 11 \AA).

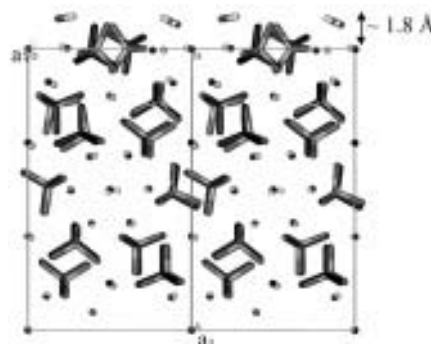


Fig. Refined surface structure model of the orthorhombic unit cell of fluorapatite in humid N_2 atmosphere with 75% r.h. the bulk structure is colored in black and the refined structure is displayed multicolored (Ca green, PO_4 red-orange, F blue, H_2O red-white). Orthorhombic unit cell is displayed (xz projection).

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