B 8 0 7 Interfacial Interaction between Hydroxyapatite and Organic Functional Groups

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In biomineralization processes such as the formation of bone, tooth, shell etc., cells create some organic matrices as a substrate for nucleation and successive precipitation of inorganic crystals, owing to the interfacial interaction between inorganic/organic materials. Especially, the self-assembling process of hydroxyapatite (HAp) in bone leads to the architectures that are customized for the unique properties of bone. Researches on the interfacial interaction between HAp and organic materials give valuable insights into the synthesis of novel biomaterials with highly controlled textures.

In the present study, organic monolayer films with carboxyl groups were prepared by Langmuir-Blodgett (LB) method. When the LB films were settled in a simulated body environment, carboxyl groups induced HAp nanocrystallites that comprise hemispherical aggregates on the LB monolayer surfaces. A scanning electron microscope (SEM) image of the aggregate is shown in Fig. 1. The obtained HAp crystallites were preferentially oriented with their **c**-axes in a specific direction parallel to the LB film near the inorganic/organic interface, suggesting that the HAp nanocrystallites could be aligned by the interaction with carboxyl groups in the LB monolayer. If the topography observed and crystallographic properties are taken into account, HAp crystal growth on the LB film, with one of {100} faces in parallel to the interface, is suggested.

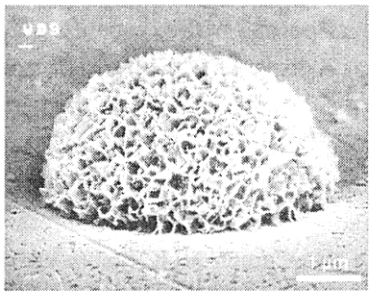

Fig. 1 SEM image of the HAp aggregate on the LB film.

As HAp {100} faces were supposed to interact with organic matrices, the structure of {100} interfaces of sintered HAp was characterized with high-resolution transmission electron microscopy (HRTEM). Grain boundaries and interfaces between vitrified and crystalline regions parallel to {100} planes were studied (Fig. 2). In both of the observations, HAp crystal structure was terminated with a plane crossing the hydroxyl columns, where exist PO_4 tetrahedra and Ca(2) ions. We propose the atomic arrangement as the most stable structure of the {100} facet.

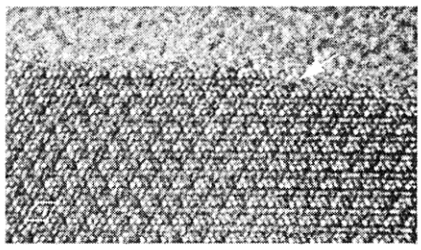

Fig. 2 HRTEM image of the grain boundary parallel to the {100} plane. The unit cell of HAp is outlined in the micrograph.

It was suspected that the interaction between calcium ions on the {100} faces of HAp and carboxyl groups in organic substances plays an essential role in the self-organization of bone.