

s5.m15.o1 **Study of Crystallographic Aspects of the Formation of pearlite in Carbon Steels Using Transmission Electron Microscopy.** Ping Liu, *Research and Development Centre, Sandvik Materials Technology, Sweden, and Research and Development Centre, Sandvik Materials Technology, SE 811 81 Sandviken, Sweden. E-mail: ping.liu@sandvik.com*

**Keywords: Pearlite; Carbon Steels; TEM**

Pearlite consists of alternative layers of ferrite ( $\alpha$ ,  $Im\bar{3}m$ ,  $a=2.8664 \text{ \AA}$ ) and cementite ( $Fe_3C$ ,  $Pnma$ ,  $a=5.0910 \text{ \AA}$ ,  $b=6.7434 \text{ \AA}$  and  $c=4.5260 \text{ \AA}$ ). The formation of pearlite is considered to be relevant to the behaviour of most steel although it is thermodynamically metastable [1]. Honeycombe based on the free energy calculation gave a pearlite growth model [2].

In the present study formation of pearlite in steel was characterised using transmission electron microscopy (TEM) and crystallographic aspects were revealed. It was shown by electron diffraction that the layers structure of pearlite were parallel to the crystallographic planes of  $(200)_{Fe_3C} // (222)_\alpha$  and the elongated direction of the cementite is parallel to the crystallographic direction of  $[002]_{Fe_3C} // [\bar{1}\bar{1}0]_\alpha$  and the third detention of the cementite is the crystallographic direction of  $[010]_{Fe_3C} // [\bar{1}12]_\alpha$ . Based on these results a modified model for pearlite growth is given in Fig.1. The morphology of pearlite can now be interpreted in terms of differences in the lattice mismatch and anisotropy diffusion. Large lattice mismatch facilitates the growth and the so-called short-path diffusion through dislocation and grain boundaries is anisotropic.

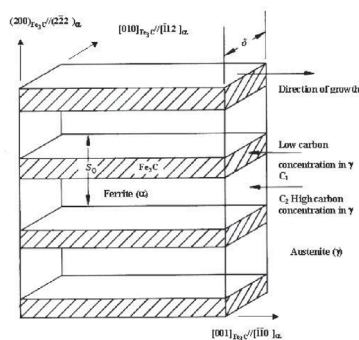


Fig.1. The crystallographic aspects of pearlite growth.

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 [2] Idib.pp28-54.

s5.m15.o2 **Biomining and Stability of Framboidal Greigites.** A. Preisinger, *Technical University of Vienna, Mineralogy. E-mail: apreisin@mail.zserv.tuwien.ac.at*

**Keywords: Biomining; Greigite; Black Sea**

The biomining of framboidal greigites is a biologically controlled mineralization, where ferrimagnetic iron sulfide, greigite ( $Fe_3S_4$ ), is crystallised intracellularly in bacterial magnetosomes of sulfate reducing bacteria (SRB) [1].

Transmission electron microscopy (TEM) observations of framboidal greigites from a sediment core of the Black Sea [2] are shown in Fig. 1.

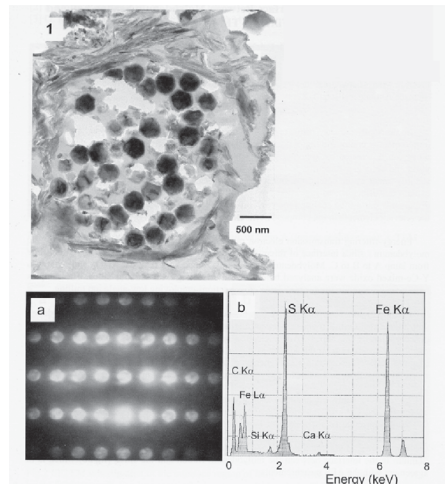


Fig. 1 TEM bright field image of an ultramicrotome section of a framboidal greigite. a. Convergent beam electron diffraction (CBED), b. EDX analysis [3].

The single crystals show the cubic symmetric structure of a ferrimagnetic inverse thiospinel,  $Fe^{2+}Fe^{3+}_2S_4$ , having a cell-edge length  $a = 9.868 \text{ \AA}$  [4]. The isometric crystals of  $\sim 0.5 \mu m$  exhibit  $\{111\}$  as the dominant form accompanied by  $\{100\}$ . Each of the single crystals was surrounded by a membrane. These individual cubo-octahedral microcrystals are packed into a regular 3-D array within the framboid. Each greigite octahedron is tetrahedrally coordinated by 4 octahedra over  $\{111\}$  to form a 3-D array and with 4 vacancies in form of icosahedra, where the triangles of the octahedra and icosahedra are of the same size. One icosahedron is surrounded by 20 octahedra. The formation of framboidal greigites in the Black Sea may have begun with a symbiosis of SRB and methanogenic archaea (MA) in the chemocline zone and their sedimentation to the anoxic bottom of the Sea. The diameters of the MA are a factor 1.5 greater than those of the SRB [5]. In our model the exchange reaction  $SO_4^{2-} + CH_4 \rightarrow SH + HCO_3^- + H_2O$  takes place over the membranes of both bacteria. The MA correspond to the icosahedra and the SRB to the octahedra. The icosahedra form a close package of 74 % together with 26 % of the 3D-octahedra array. The framboidal greigites are stable under anoxic conditions. Under influence of oxygen the greigite is changed partially to pyrite.

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