The rise and fall of melting temperatures

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The path of science has never been straight. The same holds for high pressure studies that led not only to amazing discoveries but also to numerous confusions. I will analyze the history of high pressure studies on iron phase diagram and show, how insight into the physics of the related processes allows to resolve current controversies. I will report the latest theoretical data on some metallic phase diagrams. A particular emphasis will be on the stabilization of the high-PT body-centered cubic (bcc) Fe under conditions of the Earth Inner Core[1] and how its stabilization interfere in the interpretation of iron melting curve and resolution of related enigmatic questions.

The mechanism of the high-PT bcc Fe phase stabilization is quite unique. The atoms in this structure move at times as in a liquid[2]. Therefore, the mean square displacement never saturates and the diffusion coefficient and the viscosity of the bcc Fe are similar to those in very viscous liquid[3].

Recently, our theoretical prediction of the stability of high-PT bcc Fe phase[1,4] was confirmed by diamond anvil cell experiments[5]. Interesting, that when a number of the experimental studies analyzed with the knowledge of the physics of the bcc Fe phase, those experiments confirm the stability of the new phase rather than contradict it.

I will show how the X-ray diffraction pattern of the bcc Fe looks like and discuss whether similar XRD patterns have already been observed in Fe high-PT melting experiments. I will demonstrate that the stabilization of the bcc phase was at times misinterpreted as melting.

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