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Al-Si-C ternary alloys: a “new” family of semiconductors

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Abstract

The Al-Si-C system contains an important class of ternary ceramic carbides with the general formula $\text{Al}_4\text{C}_3(\text{SiC})_n$. Because of their high thermal conductivity, high strength and good wear resistance; the Al-Si-C-based ceramic materials are used in both modern power electronics as heat-exchange materials and in weight sensitive applications. Considered the viewpoint of structural materials, it is only recently the electronic structure of Al_4SiC_4 ternary alloy has been investigated theoretically through the *ab initio* calculations resulting to an indirect bandgap of 1.05eV. The combination of both semiconducting and ceramic type properties makes these compounds “new” candidates for many applications which require wide bandgap, high thermal conductivity and high temperature resistance, such as power electronics.

Our group has achieved the growth of Al_4SiC_4 single crystals in the mm scale that are transparent to visible light indicating a wide band gap in contradiction to the theoretical prediction. The implementation of the crystal growth process of this compound together with the first experimental and theoretical results regarding their physical properties such as electronic or optical will be presented.