Push-Pull Alloys: the nucleation of complexity in metallic alloys

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Wedraw attention toA-B-C ternary alloys, in which the elemental constituents A, B and C are chosen in such a way that B-C interactions are repulsive, but A-B and A-C are attractive in the respective binary systems. Such“**push-pull alloys”** are reminiscent of amplifiers designed to amplify electric signals. Push-pull alloys amplify complexity, forming complex intermetallics with tens to thousands atoms per unit cell. Few of them lead to the ultimate degree of complexity, when quasiperiodic order substitutes for crystal periodicity, which opens the way to discovering unprecedented properties such as heat insulation in $Al_{62}Cu_{25}Fe_{13}$ (at. %). Many more compounds are known today, which share the same elemental characteristics (the picture may be extended to specific binary alloys). The case of push-pull alloys will be exemplified with electronic structure data already published as well as with original material obtained on ternary systems such as Gd-Ca-Cu and Al-Sc-Cr alloys as well as in (Ce,Al)-Cu-Fe metallic glasses.