

Ole Krogh Andersen, *What is special about MgB₂?*

Two years ago, Akimitsu and collaborators discovered superconductivity below $T_c=39$ K in the readily available compound MgB₂ (Mg⁺⁺B₂⁻) which is isostructural and isoelectronic with graphite. Within months, density-functional calculations and measurements provided strong evidence that the mechanism is the conventional electron-phonon coupling. The reason why T_c is orders of magnitude larger than for intercalated graphite, and considerably higher than for alkali-doped C₆₀, is that the intercalated Mg⁺⁺-ions lower the B p_z π -bands so far with respect to the B sp^2 σ -bands that electrons are depleted at the top of the bonding σ -band. These holes couple strongly to the optical bond-stretching modes with $q < 2k_F$, so that the latter broaden considerably, soften by nearly a factor two, and also become anharmonic and thereby harden again by 15 %. As a result, $\lambda_{\sigma\sigma} \sim N_{\sigma}(0) D^2/M\omega^2 \sim 0.7$. A number of experimental properties (*e.g.* electronic specific heat, tunnelling, and infrared optical properties) are only now becoming understood in detail. It turns out that except in severely damaged samples, the impurity scattering between the σ and π bands is orders of magnitude smaller than the $\sigma\sigma$ and $\pi\pi$ intraband scatterings, so that different gaps persist on the σ and π Fermi-surface sheets, although the interband electron-phonon coupling ($\lambda_{\sigma\pi}$) causes them to close at a common T_c . Also this makes MgB₂ unique. Other possible materializations of superconductivity based on σ -holes coupling to optical bond-stretching modes may be thought about.

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