Thermoelectric power mapping and electron-phonon coupling in $Mg_{1-x}Al_xB_2$ and $MgB_{2-x}C_x$ single crystals

T. Toliński[1,*] and K. Rogacki[2]

[1]Institute of Molecular Physics, Polish Academy of Sciences, Poznań, Poland
[2]Institute of Low Temperature and Structure Research, Polish Academy of Sciences, Wrocław, Poland
[*]*tomtol@ifmpan.edu.pl*

The discovery of superconductivity in a simple binary compound, MgB_2, in 2001 [1] sparked considerable interest in this material, including engineering its properties through various doping. MgB_2 has the critical temperature of T_c = 39 K, which is surprisingly high compared to conventional superconductors, and crystallizes in a hexagonal AlB_2-type structure, where layers of boron atoms form honeycomb lattices separated by magnesium layers. We studied single crystals of MgB_2 and its doped variants because they offer a unique opportunity to investigate the fundamental mechanisms of superconductivity and the anisotropic properties.

In the current study, we demonstrate that plotting maps of the Seebeck coefficient S as a function of temperature and substitution level x for $Mg_{1-x}Al_xB_2$ and $MgB_{2-x}C_x$ clearly highlights the anisotropy of the thermoelectric power and better illustrates different effects resulting from the doping at the Mg and B sites [2, 3]. For the superconducting state, we propose a simple estimation of the Debye temperature change with the doping by calculating a mass correction, which then allows us to determine the electron-phonon coupling as a function of doping level.

References

[1] J. Nagamatsu *et al*., Nature 410, 63 (2001).
[2] S. M. Kazakov *et al*., Phys. Rev. B 71, 024533 (2005).
[3] T. Toliński *et al*., J. Mater. Sci. 59, 16184 (2024).