Tuning magnetism in the rare earth (RE) $REIr_3$ and $RENiC_2$ intermetallic compounds

Tomasz Klimczuk[1]

[1] *Faculty of Applied Physics and Mathematics, and Advanced Materials Centre, Gdansk University of Technology, Gdansk, Poland*

The attractiveness of lanthanide based compounds comes from a unique opportunity to tune the magnetic properties. For example, it has been shown by Berndt Matthias that 1% of Gd diluted in La already suppresses superconductivity, and, with as little as 3% of Gd, a ferromagnetic state is observed with a Curie temperature $T_C = 1.3$ K. Meanwhile, the borocarbide RET_2B_2C (RE = rare-earth, T = Ni, Pd, Pt) family is probably the most intensively studied among RE-based compounds. The most remarkable features of the physical properties in RET_2B_2C is the coexistence of superconductivity with long range magnetic ordering.

In this lecture I would like to discuss recent results obtained in two other fascinating rare earth families: $REIr_3$ and $RENiC_2$. In the first, superconductivity is observed for $LaIr_3$ and $CeIr_3$, whereas $PrIr_3$ and $NdIr_3$ are ferromagnets. A heavier rare-earth metal can also be used (Gd-Ho) but the crystal structure changes from $PuNi_3$-type to $AuCu_3$-type and a long range magnetic behavior is preserved.

The second family to be presented, will be the ternary carbide $RENiC_2$ system, in which various unusual physical properties are observed. $LaNiC_2$ is a noncentrosymmetric superconductor with $T_{sc} = 2.9$ K, while $YNiC_2$ and $LuNiC_2$ were reported to be paramagnetic down to 1.9 K. $SmNiC_2$ is a ferromagnet with Curie temperature $T_C = 17.5$ K whereas the other lanthanide based $RENiC_2$ (with the exception of $PrNiC_2$) reveal antiferromagnetic behavior with Néel temperatures varying from 25 K for $TbNiC_2$ to 3.4 K for $HoNiC_2$. Moreover, $RENiC_2$ compounds (with the exception of La and Ce) show charge density wave formation. The Peierls temperature shows remarkably linear behavior from Sm to Lu and T_{CDW} exceeds 300 K for the heaviest lanthanides (Ho – Lu).

This work was supported by the National Science Centre (Poland), Grant No. 2017/27/B/ST5/03044.