Thermocurrent spectroscopy of Yu-Shiba-Rusinov states in single-molecule junctions

S. Volosheniuk[1], D. Vogel[2], C. Wegeberg[2], M. Mayor[2,3,4], H.S.J. van der Zant[1,*] and P.Gehring[5,*]

[1]Kavli Institute of Nanoscience, Delft University of Technology, The Netherlands
[2]Department of Chemistry, University of Basel, Basel, Switzerland
[3]Institute for Nanotechnology (INT), Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany
[4]Lehn Institute of Functional Materials (LIFM), School of Chemistry, Sun Yat-Sen University (SYSU), 510275 Guangzhou, China
[5]IMCN/NAPS, Université catholique de Louvain, 1348 Louvin-la-Neuve, Belgium
** - this authors contributed equally*

The interaction between magnetic impurities and superconductors leads to fascinating physical phenomena resulting from the competition between Kondo screening and Cooper pair formation [1]. To this end, individual magnetic impurities can form states within the superconducting gap, called Yu-Shiba-Rusinov (YSR) states [1,2]. YSR states are of great interest because they have the potential to realise topological superconductivity. Here we show that such YSR states form in a neutral and stable all-organic radical molecule coupled to proximity induced superconducting break-junction electrodes. We experimentally study the thermoelectric response [3] of the system at mK temperatures, both in the YSR regime and – by applying magnetic fields – in the Kondo regime [4]. Ultimately, we observe a two-fold increase of the thermoelectric efficiency which is induced by the YSR states. This study highlights the power of thermocurrent measurements as a new spectroscopic tool to study nanoscale devices, and reveals new strategies for engineering highly efficient thermoelectric energy conversion at cryogenic temperatures.

References

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