Contribution ID: **98** Contribution code: **S06-CMPSP-109** Type: **Oral presentation**

The magnetothermopower of organic superconductor $\kappa-(\mathrm{ET})_2\mathrm{Cu}(\mathrm{NCS})_2$: possible charge density wave scenario

Tuesday 30 August 2022 14:30 (15 minutes)

The interlayer magnetothermopower of the organic superconductor $\kappa-(\mathrm{ET})_2\mathrm{Cu}(\mathrm{NCS})_2$ is studied at temperatures down to 0.5 K and fields up to 32 T. Analysis of the background magnetothermopower show that at low temperatures it is negative and exhibits an upturn at higher field, producing a dip at a field close to the upper critical field B_{c2}. There are clear magnetothermopower quantum oscillations visible above 5 T. The obtained oscillation frequencies are in a good agreement with those previously reported on the magnetoresistance and magnetization quantum oscillations. According to our results, the magnetothermopower in $\kappa-(\mathrm{ET})_2\mathrm{Cu}(\mathrm{NCS})_2$ presents features which have already been detected in YBCO and other high-T_c cuprates indicating that some kind of a charge density wave order is also present in the normal state of $\kappa-(\mathrm{ET})_2\mathrm{Cu}(\mathrm{NCS})_2$. Most strikingly, our measurements show that there is another dip, again followed by an upturn, in the magnetothermopower of $\kappa-(\mathrm{ET})_2\mathrm{Cu}(\mathrm{NCS})_2$ occurring at much higher fields than B_{c2}, around the magnetic breakdown field of $\sim$ 21 T that is not present in YBCO. We propose that the two induced successive phase transitions, consisting of two similarly ordered states each restricted to a finite magnetic field window are in fact charge density wave ordered states arising as a result of the layer-stacking mechanism in the interlayer direction. Our results support and advance some of the previous findings that the superconductivity in the organic superconductor $\kappa-(\mathrm{ET})_2\mathrm{Cu}(\mathrm{NCS})_2$ is mediated by a charge density wave order rather than antiferromagnetic fluctuation.

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Session Classification: S06 Condensed Matter Physics and Statistical Physics

Track Classification: Scientific Sections: S06 Condensed Matter Physics and Statistical Physics