Magneto-Seebeck effect in RFeAsO (R = rare earth) compounds: Probing the magnon drag scenario

F. Caglieris\textsuperscript{1,2}, A. Braggio\textsuperscript{1,2}, I. Pallecchi\textsuperscript{2}, A. Provino\textsuperscript{2,3}, M. Pani\textsuperscript{2,3}, G. Lamura\textsuperscript{2}, A. Jost\textsuperscript{4}, U. Zeitler\textsuperscript{4}, E. Galleani D’Agliano\textsuperscript{1}, P. Manfrinetti\textsuperscript{2,3}, M. Putti\textsuperscript{1,2}

\textsuperscript{1}Department of Physics, University of Genova, Via Dodecaneso 33, 16146 Genova, Italy
\textsuperscript{2}Institute SPIN-CNR, Corso Perrone 24, 16152 Genova, Italy
\textsuperscript{3}Department of Chemistry, University of Genova, Via Dodecaneso 31, 16146 Genova, Italy
\textsuperscript{4}High Field Magnet Laboratory, Radboud University of Nijmegen NL-65000 GL Nijmegen

PHYSICAL REVIEW B 90, 134421 (2014)

In this work, we carried out a careful analysis of the Seebeck effect ($S$) in the 1111 (RFeAsO, with R=rare earth) parent compounds with different R and different degrees of disorder. We explored the dependences on temperature, observing a puzzled and articulated phenomenology (Figure 1 a)). The multiband character of these compounds seems to be insufficient to explain the behavior of the thermopower. In particular we elaborated a simplified model for the multiband diffusive contribution based on Mott-formula, verifying that it doesn’t account for the local minimum around 50 K. To study this feature we performed some measurements of Seebeck effect as a function of magnetic field up to 30 T (Figure 1 b)) at the HFML laboratories of Nijmegen. The Seebeck values increase in magnitude with rising the field with a tendency to saturation observed at the low temperature. For this scenario we propose an interpretation based on magnon-drag by antiferromagnetic spin waves. To support our thesis we have developed a theoretical model for AFM-magnon drag contribution, identifying a scaling behavior as a function of the ratio B/T, well obeyed by experimental data (Figure 1 c)). The existence of a dominating magnon-drag contribution in the 1111-parent compounds is an important evidence of the strong interaction between charge carriers and spin waves. Within this picture the Seebeck effect comes out to be a privileged property which effectively probes the coupling mechanisms supposed to induce unconventional superconductivity.

![Figure 1: a) (Color online) Seebeck coefficient curves of RFeAsO (R = Sm, Pr, La, Ce) polycrystals, b) (Color online) S curves versus the magnetic field of theLaFeAsO sample performed at T = 30, 45, 60, and 77 K c) (Color online) AFM magnon drag contribution to the Seebeck effect $MS^{\text{AFM}}(T,B)=[S(T,B)-S(T,0)]/S^{\text{DRAG}}(T)$ extracted from the experimental S curves of Fig. 1 b) and plotted as a function of B/T.](image-url)