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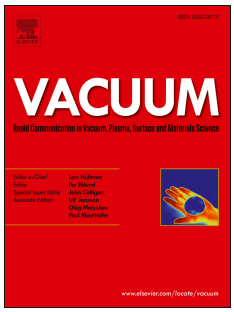

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Electrical resistivity modulation of thermoelectric iron based nanocomposites

Denis Music[a,*], Paul Schmidt[a], Zsolt Czigány[b], Grzegorz Greczynski[c], Richard W. Geyer[a], Marcus Hans[a]

[a] Materials Chemistry, RWTH Aachen University, Kopernikusstr. 10, D-52074 Aachen, Germany

[b] Institute of Technical Physics and Materials Science, Centre for Energy Research of Hungarian Academy of Sciences, Konkoly Thege Miklós út 29-33, H-1121 Budapest, Hungary

[c] Thin Film Physics Division, Department of Physics (IFM), Linköping University, SE-58183 Linköping, Sweden

[*] Corresponding author. *E-mail address:* music@mch.rwth-aachen.de (D. Music)

ABSTRACT

Iron oxides are promising thermoelectrics, but their high electrical resistivity impedes broader applications. In this work, we have studied Fe oxides with metallic contributions. Pt and Ir additions are also considered to enhance the valence electron concentration and further modify the transport properties. Based on density functional theory explorations, Fe based clusters (Fe_3, Fe_4, and Fe_3Pt) are suggested to act as nucleation sites for metallic crystallites, while O leads to formation of an amorphous matrix. This has been validated by transmission electron microscopy and x-ray photoelectron spectroscopy of sputter-grown Fe-Pt-Ir-O thin films. Densely packed bcc Fe grains, approx. 2 – 3 nm in diameter, are embedded in an amorphous Fe-O matrix in the as-grown state. The Seebeck coefficient reaches even -411 $\mu V\ K^{-1}$ and the electrical resistivity is up to 5 orders of magnitude lower than that of previously reported literature data on Fe oxides.