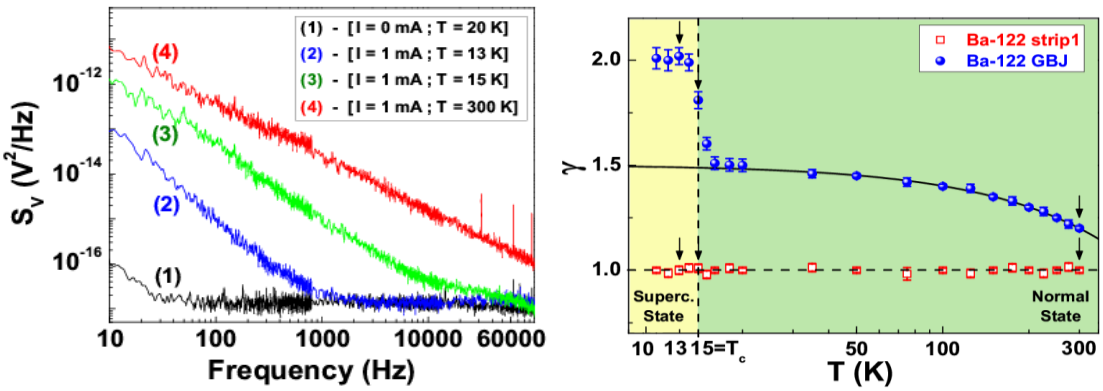
Probing transport mechanisms of $BaFe_2As_2$ superconducting films and grain boundary junctions by noise spectroscopy

C. Barone [1,2], F. Romeo [1,2], S. Pagano [1,2], M. Adamo [2], C. Nappi [3], E. Sarnelli [3], F. Kurth [4] & K. Iida [4]

[1] Dipartimento di Fisica "E.R. Caianiello", Università di Salerno, I-84084 Fisciano, Salerno, Italy
[2] CNR-SPIN Salerno, Università di Salerno, I-84084 Fisciano, Salerno, Italy
[3] CNR-SPIN Napoli, Via Campi Flegrei 34, I-80078 Pozzuoli, Napoli, Italy
[4] Leibniz-Institut für Festkörper- und Werkstoffforschung (IFW) Dresden, 01171 Dresden, Germany

SCIENTIFIC REPORTS 4, 6163 (2014)

The discovery of iron-based superconductors has been an important step forward for the understanding of high-temperature superconductivity. In addition, iron pnictides could be used for high-field magnet applications, resulting more advantageous over conventional superconductors, due to a high upper critical field as well as its low anisotropy at low temperatures. Grain boundaries are, however, the principal obstacle in fabricating high quality superconducting wires and tapes. To investigate these effects, the dc transport and voltage-noise properties of Co-doped $BaFe_2As_2$ superconducting films with artificial grain boundary junctions (GBJs) have been measured. Using a specific procedure, the film noise can be separated from that of the grain boundary junctions. While the former shows a standard 1/f behaviour, the latter is characterized by an unconventional temperature-dependent multi-Lorentzian voltage-spectral density. Moreover, below the film superconducting critical temperature, a peculiar noise spectrum is found for the GBJ. The presence of a small number of fluctuating Josephson weak-links seems to be a crucial ingredient to explain the noise of the GBJ in the superconducting state.



(Left) Frequency dependence of the voltage-spectral density, at three reference temperatures and at a fixed bias current, for the strip containing a grain boundary junction. (Right) Temperature dependence of the noise frequency exponent γ. Red open squares refer to the strip without the grain boundary junction; blue full circles refer to the intrinsic grain boundary junction.