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Electric field induced Verwey transition in single magnetite nanoparticles QIAN YU, ALIREZA MOTTAGHIZADEH, HONGYUE WANG, LPEM, ESPCI-ParisTech-UPMC-CNRS, Paris, France, CHRISTIAN ULYSSE, Laboratoire de Photonique et de Nanostructures, CNRS, Marcoussis, France, VALENTINA REBUTTINI, NICOLA PINNA, Humboldt-Universität zu Berlin, Institut für Chemie, Brook-Taylor-Str. 2, 12489 Berlin, Germany, ALEXANDRE ZIMMERS, HERVE AUBIN, LPEM, ESPCI-ParisTech-UPMC-CNRS, Paris, France — In 1939, E.J.W. Verwey discovered that in magnetite (Fe3O4) electrons localize below a temperature T $\sim$ 120 K. He suggested that charge transport is due to electron exchange between ferric (Fe3+) and ferrous (Fe2+) sites and the metal to insulator transition is due to the ordering of Fe cations into alternating layers of Fe3+ and Fe2+ ions. Using a method recently developed to fabricate single nanoparticle circuits, we trapped single nanoparticles of magnetite between nanometer-spaced electrodes that we used to study the electronic spectrum of the nanoparticles as function of temperature across the Verwey transition. In this tunnelling spectrum, we find the signature of polarons states. As function of temperature, one can observe that the density of states decreases to zero as the temperature approach the Verwey transition. Below the Verwey temperature, a clear gap is observed in the tunnelling spectrum. Above the Verwey temperature, no gap is observed. The absence of this gap indicates that electronic transport in the normal state of magnetite is due to polaron hopping, in contrast to the alternative scenario of activated band-like electronic transport. This work was supported by the French ANR grants 10-BLAN-0409-01 and 09-BLAN-0388-01.

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