

Title: Formation of oriented nickel aggregates in rutile single crystals by Ni implantation

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Abstract: The magnetic and electrical properties of Ni implanted single crystalline TiO₂ rutile were studied for nominal implanted fluences between $0.5 \times 10^{17} \text{ cm}^{-2}$ and $2.0 \times 10^{17} \text{ cm}^{-2}$ with 150 keV energy, corresponding to maximum atomic concentrations between 9 at% and 27 at% at 65 nm depth, in order to study the formation of metallic oriented aggregates. The results indicate that the as implanted crystals exhibit superparamagnetic behavior for the two higher fluences, which is attributed to the formation of nanosized nickel clusters with an average size related with the implanted concentration, while only paramagnetic behavior is observed for the lowest fluence. Annealing at 1073 K induces the aggregation of the implanted nickel and enhances the magnetization in all samples. The associated anisotropic behavior indicates preferred orientations of the nickel aggregates in the rutile lattice consistent with Rutherford backscattering spectrometry-channelling results. Electrical conductivity displays anisotropic behavior but no magnetoresistive effects were detected. (C) 2013 Elsevier B.V. All rights reserved.

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