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Raman Study of the Verwey Transition in Magnetite (Fe_3O_4) at High Pressure and Low Temperature: Effect of Aluminum Doping
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Raman spectra of pure and doped magnetite provide a set of markers allowing one to study how the Verwey transition in magnetite changes with the change of pressure. At ambient pressure Verwey transition temperature, Tv, of the single crystals of magnetite, Fe3O4, is determined to be 123K. High-pressure experiment indicates strong dependence of the change of pressure vs. change in the Verwey transition temperature on the amount of impurities: for pure Fe_3O_4 the change is -0.2 GPa/K; for doped iron, $Fe_{2.98}Al_{0.02}O_4$, the change is -0.09 GPa/K. Aluminum-doped magnetite ($Fe_{2.98}Al_{0.02}O_4$) where Al substitutes Fe^{+2} and Fe^{+3} atoms, represents a 2% aluminum doping, which shifts the Verwey transition temperature to T_v=118.5K. The rate with which the Verwey temperature decreases with pressure is further discussed based on the molar specific heat measurements.

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