Fabrication of Mn-doped magnéli phase titanium oxides

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Recently much effort has been tried to search dilute magnetic semiconductor (DMS) which is composed of ferromagnetic ions embedded into the semiconductor matrix. DMS is essential for magnetically polarized carrier injection into the non-magnetic matrix holding a particular spin direction. Many attempts to fabricate high Curie temperature DMS[1,2] have been made based on semiconductors such as ZnTe, CdTe, GaAs, GaN, ZnO etc. Whether structural stability of the DMS is associated with intrinsic physical property is however still debated.

In this study titanium sub-oxides, Ti_nO_{2n-1} ($4 \leq n \leq 10$), which are called *magneli phase*[2] were prepared for DMS application. It is conjectured that titanium sub-oxides can be used as the DMS matrix because they possess high electronic conductivity and accommodations of ferromagnetic ion.

Manganese was substituted for titanium in TiO_2 until 3% mole fraction. Then it was annealed at reducing atmosphere over 1000°C changing the TiO_2 to a reduced *magneli phase*. Oxygen partial pressure and temperature were carefully controlled to obtain *magneli phase* flowing the H_2/Ar gas mixture. By the solid state reaction method, the sintered ceramics in pellet form could be obtained as a consequence. Its electronic resistivity was an order of mΩ/cm, which was similar to that of ZnO. Solid solubility of Manganese ion and its electronic valence status in the matrix were estimated by XRD and XPS.

References

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