Highly electron doped TaON single crystal -growth and properties-

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Transition metal oxynitrides have attractive properties such as visible-light responsive catalysts, nontoxic pigments, ferroelectricity and magnetic properties. Recently In the double perovskite La_2MnTaO_5N, partial anion order enhances spin frustration despite a small tolerance factor.[1] In order to reach a deeper understanding of the observed properties of transition metal oxynitrides, measurements using single crystals are of crucial importance. For $BaTaO_2N$ by using $BaCN_2$ flux cubic transparent single crystals were grown to a size of approximately 3.1 μm and ferroelectricity with complete phase inversion was observed on an oxynitride perovskite crystal for the first time.[2] However, single crystals were limited to relatively small ones (less than 10 μm), because transition metal oxynitrides are easily decomposed into oxides or reduced at high temperature.

Using a flux method, we have succeeded in growing platelet single crystals of TaON , with a typical size of 50 × 100 × 10 μm^3. In contrast to the reported yellow powder samples, the obtained crystals contain a large amount of oxygen vacancy (x = 0.06 in $TaO_{1-x}N$) and exhibit a metallic behavior with a large anisotropy of $\rho_c/\rho_{ab} \sim 10^3$, in contrast to the previously reported Ta-based oxynitride powder specimens, which are insulators. Moreover, we could grow different crystal morphologies by changing the flux choice. In this presentation, we will present the detailed studies of highly doped TaON single crystal and its physical properties.

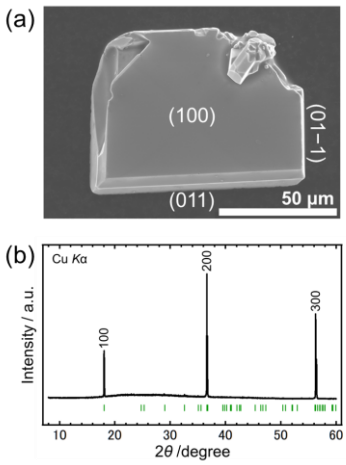

Figure 1. (a) SEM image of TaON single crystal. (b) XRD patterns of TaON crystal.

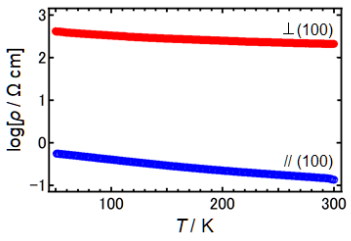

Figure 2. Temperature dependence of electrical resistivity ρ in TaON black crystal, demonstrating high anisotropy.

References

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