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Evaluation of the physical properties and the real space observation in 2*H*-TaS_2 synthesized with flux method

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The physical properties of the layered compounds can be changed by the intercalation of the metal ion, organic molecules, and so on. In transition metal dichalcogenide (TMDC) 2*H*-TaS_2, which shows superconductivity and charge density wave (CDW) state, the intercalation of the metal ion increases the superconducting transition temperature and changes the superstructure. Although intercalation is useful to tune physical properties of TMDC, up to present, the intercalation technique in TMDC is restricted to a few methods, such as electrochemical or vapor transport technique, and intercalants are also restricted. Thus, it is necessary to find the more methods of the intercalation.
In this study, we tried to grow single crystal 2*H*-TaS_2 with flux method to intercalate elements which are included in the flux. NaCl and KCl were used as flux. It was found that the potassium is included in the single crystals grow by the flux method from the EDX measurements. The measurements of the electrical resistivity showed the transition temperature to the superconducting state became higher than that in the pristine crystal. Scanning tunneling microscopy / spectroscopy (STM/STS) measurements at 4.2 K revealed the superstructure which is different from that of the CDW in the pristine 2*H*-TaS_2. Considered these results, it is concluded that the potassium included in the flux is intercalated with 2*H*-TaS_2 by single crystal growth with flux method. In the presentation, how the potassium is intercalated with 2*H*-TaS_2 will be discussed.

Keywords: intercalation, CDW, 2H-TaS2, STM/STS