Low-Energy Direct Synthesis of Potassium Tantalate by Hydrothermal Synthesis with Ethanol on a Substrate

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Potassium tantalate thin films have been studied for the development of electric capacitors. The alkali and alkaline earth tantalates such as $KTaO_3$ and $BaTa_2O_6$ have been focused on the photo catalysts for water decomposition [1]. Potassium tantalate films have been formed by chemical vapor deposition (CVD), sol-gel process, liquid phase epitaxy and sputtering techniques. These fabrication techniques of films need high energy because of the requirements for either high vacuum or high temperature, and the precision instruments. The film formation has been synthesized easily below 473 K by using hydrothermal synthesis method.

Potassium tantalate film was formed on a tantalum electrode with 3-5 mol% KOH solution and above 353 K in hydrothermal electrochemical conditions. This film was Pyrochlore type in this condition. Pyrochlore type potassium tantalate with amorphous state was formed below 2 mol% or 353 K [2]. Perovskite type potassium tantalate was fabricated by annealing at about 1100 K [3]. If a precursor of perovskite dioxide was produced on a substrate by sputtering or a sol gel process, it needed to anneal a substrate at 873 K. Some perovskite type oxide films such as $SrTiO_3$ have functions as a detector of some gases with scales of ppm or ppb. These films may be carried out to humidity detector at high temperature (900K or more) [4].

The direct formation of a perovskite type potassium tantalate film such as $KTaO_3$ with porous surface on the substrate has been studied. Potassium tantalate films were synthesized in ethanol added potassium hydroxide solution at temperatures below 473 K by hydrothermal synthesis. The growth of the film is thought to be controlled by changing the amount of ethanol. The effect of added methanol in the solution was also examined to control the morphology of potassium tantalate. Perovskite type potassium tantalate was synthesized at high concentration ethanol solvent at 423 K. At lower concentration, pyrochlore type potassium tantalate was synthesized. The higher concentration of ethanol, the smaller grain size of potassium tantalate grew.

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