Preparation and electrical properties of tantalum silicate thin films

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The electric resistivity and temperature coefficient of resistivity (TCR) of a material are important parameters when developing thin-film resistors for advanced electronics and electricity consumption. There are many materials that can be applied to thin film resistors, among which the tantalum silicate (Ta-Si-O) thin film material has attracted much attention, which is due to the excellent thermal stability and adjustable TCR of this material. However, the electrical properties of such thin film materials are highly correlated with the composition control and structure of the material. How to develop an efficient process method to more precisely control the composition and structure so as to obtain the required resistivity and TCR has always been an important issue. In the past, there were very few academic reports on the manufacturing process of these materials, so the related electrical research has been very limited. In this work, we prepared two targets with different target compositions, such as $Ta_{65}(SiO_2)_{35}$ and $Ta_{80}(SiO_2)_{20}$, to study the effects of target composition and sputtering power on the material structure and electrical behavior of the film. Our series of experimental results indicate that a Ta-Si-O film with a high Ta content can be produced by using a target material with a high Ta content, and a film with low resistivity and low TCR can be successfully produced with an appropriate sputtering power. According to material analysis, the excellent electrical properties of the film are highly related to the formation of Ta_5Si_3 as the main structural phase in the film.