

## Epitaxial Growth of TiN films on Single-crystal Si (100) Substrates with High Vacuum Magnetron Sputtering Method

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TiN is a promising material for superconducting devices. Microwave resonators with very low loss using TiN films deposited on single-crystal Si substrates have been reported. [1] To achieve excellent TiN resonators, epitaxial growth of TiN films on Si is necessary. However realizing of the epitaxial of TiN is difficult because the lattice mismatching between TiN and Si is quite large. So improvement of the quality of TiN films is an important issue. We achieved the TiN films with (200) domination deposited on single-crystal Si (100) substrates with magnetron sputtering method. We investigated the films quality with various deposition conditions and found the deposition temperature can dramatically affect the domination and crystallites of the TiN films. Without a temperature controlled substrate, the TiN sputtering was carried out at ambient substrate temperature, X-ray result shows polycrystalline and much weaker intensity of TiN (200) and TiN (111) peaks compare to the films sputtered at higher substrate temperature (Fig. 1). On the other hand, with the substrate temperature of 650 °C, the (111) peak almost disappeared and the (200) peak intensity increased dramatically. The films quality are further confirmed by R-T measurement as shown in Fig. 2. The TiN film with substrate temperature of 650 °C shows  $T_c \sim 4.9$  K, and the resistivity of  $22 \mu\Omega \cdot \text{cm}$ . Both values are much better than the films deposited under the conditions of lower substrate temperatures.

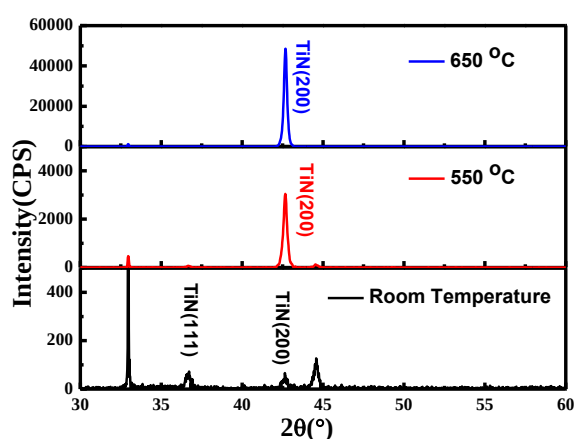


Figure 1 XRD results of films deposited under different substrate temperatures

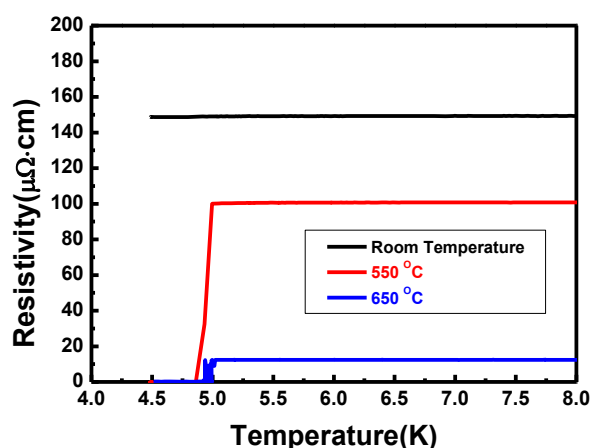


Figure 2 R-T curves of TiN films deposited under different substrate temperatures.

[1]Appl.Phys.Lett.97, 232509,2010