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In-situ high-temperature X-ray diffraction investigations of magnetron sputtered niobium oxide layers up to 900°C

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Niobium oxide films with a thickness in the range of 1.3 µm were deposited on silicon single crystal wafers by DC powered magnetron sputtering at process pressures of 0.3-0.6 Pa utilizing a 71.6 mm diameter planar substoichiometric niobium oxide ($Nb_2O_{4.8}$) target, which was powder metallurgically produced by hot isostatic pressing. After the deposition process, the layer material was completely amorphous. The primary crystallization of the hexagonal Nb_2O_5 phase and the subsequent transformation to the orthorhombic phase were investigated by means of in-situ high-temperature X-ray diffraction up to a temperature of 900°C under a reducing N_2/H_2 atmosphere. The precise determination of the cell parameters by Rietveld refinement enabled the determination of the anisotropical thermal expansion behaviour of the crystalline Nb_2O_5 phase. Besides, an activation energy of the primary crystallization reaction of +460(50) kJ/mol was quantitatively determined by isothermal in-situ experiments in the temperature range of 505-545°C.

Keywords
DC magnetron sputtering
niobium oxide
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