Uniaxially Oriented Refractory Nickel Aluminum Films Sputtered at High Temperatures

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Nickel-base superalloys containing Ti, Ta, and W are used in a base material as a turbine blade or a turbine vane of a jet engine or the like in many cases with a surface of a base material coated to inhibit high temperature oxidation and heating **[1]**. The intermetallic nickel aluminide alloy is a thermal stability of 3d transition-metal (TM) compound which exhibits high-melting point, extreme hardness, as well as low density and metal–like thermal and electrical conductivity, which makes this material ideal for technical applications. Especially, excellent oxidation resistance due to the formation of a protecting alumina layer on the surface leads to be robust against oxidation if nickel aluminum (NiAl) alloy is used at elevated temperature in air **[2]**. Based on above reasons, NiAl is a promising candidate for for high-temperature practical applications. In this research, we report on growth and characterization of uniaxially oriented NiAl films with DC magnetron sputtering and in situ heating. The films self organize into (110) orientation with low surface roughness with tight grain boundaries in columnar structure. Electrical carrier concentration and resistivity values are found to be in the orders of 10^{21} cm^{-3} and 10^{-5} Ω.cm, respectively. At growth temperatures, the electrical resistivity values are decreased to the same scale that proves the quality of film become unique and display plasmonic properties. Plasmonic performance, as judged by the dielectric function of sputtered films, are comparable to that of NiAl single crystal, even better than conventional refractory molybdenum, tungsten and titanium nitride in the visible to near-infrared wavelength region **[3-4]**. This work would pave the way to various NiAl-based plasmonic nanostructures for futuristic applications.

REFERENCES

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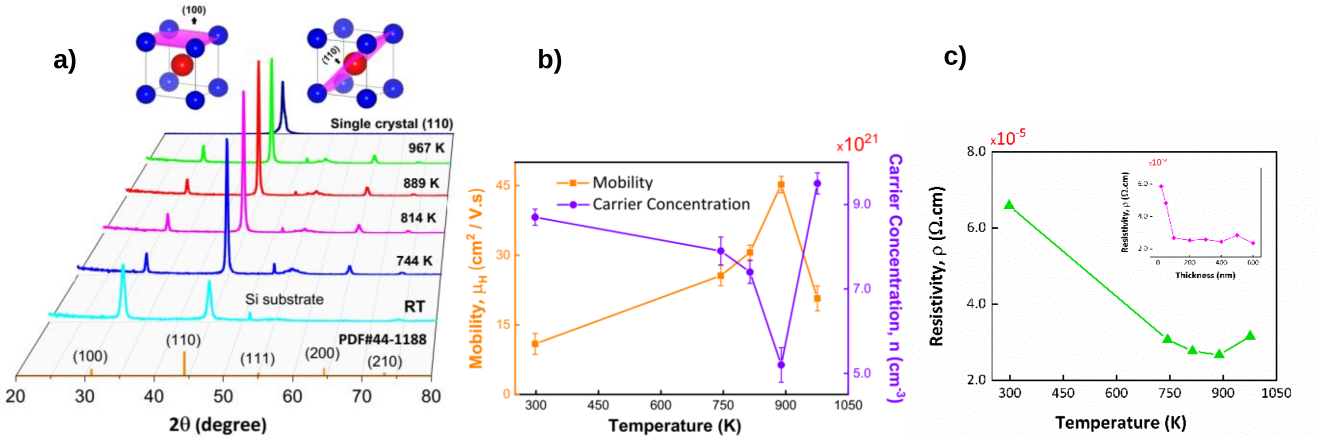
FIGURES



Figures: (a) XRD patterns of NiAl films on Si (100) substrates at different temperatures. Standard diffraction pattern of NiAl (PDF#44-1188) at the bottom. **(b)** Mobility and carrier concentration versus growth temperature, and **(c)** resistivity versus growth temperature, and effect of film thickness on the resistivity.