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Study on deposition rate and microstructure of niobium coating prepared by CVD from niobium pentafluoride

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Niobium is a metal with high thermal conductivity, high melting point, corrosion resistance, and low neutron capture cross section, which is a kind of material which is very suitable for atomic energy reactor. Adding a layer of niobium to the metal inner tube wall allows it to get a better performance for a wider range of applications. The study of the deposition rate and morphology of niobium deposition in the inner wall of the metal is of great significance for the application of niobium. In this experiment, we used niobium pentafluoride as a precursor to prepare a pure niobium coating in the inner wall by chemical vapor deposition, which was carried out in a stainless steel tube. By hydrogen reduction of niobium pentafluoride, we got a pure niobium coating on the stainless steel inner tube wall, as shown in Figure 1. After microscopic observation and SEM scanning analysis of the niobium coating, we confirmed that the niobium coating prepared was dense, high purity and uniform thickness. And it is easy to find that there was a transition layer between substrate and niobium coating, which means the coating and the substrate tightly bonded. The microstructure of niobium coating showed irregular fine grain substrate closed region and more regular columnar region and it showed a typical preferred growth mechanism. After experiment, we cut the tube along its axis to measure the thickness or deposition rate of the niobium coating at different parts of the inner wall. Figure 2(a) showed the distribution of deposition rate and temperature along the airflow direction, which was obtained by optical microscopy and thermocouple. The data obtained illustrated that the deposition rate of the coating was not only closely related to the temperature but also with the gas environment, the fastest deposition rate and dense niobium coating were obtained in the area 40-55 mm of the inner wall.

Biography

Mingmin Zheng has his expertise in the preparation of protective coating on metal surface. His major study is based on metal inner tube wall with deposited niobium coating and its kinetics and nucleation mechanism during the deposition. He has successfully obtained a pure thickness of niobium coating by hydrogen reduction of niobium pentafluoride chemical vapor deposition.

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