OR0902

Performance of HIPIMS deposited CrN/NbN nanostructured coatings exposed to 650°C in pure steam environment

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In the current work, 4 µm thick CrN/NbN coating utilising nanoscale multilayer structure with bi-layer thickness of 3.4 nm has been used to protect 9 wt.% Cr steel such as P92 widely used in steam power plants. The unique layered coatingis a combination of nitrides of chromium and niobium, which are not only resitant to aqueous corrosion and corrosion-erosion and have excellent tribological properties, but also has oxidation resistans in dry air up to a temperature of 850 ºC. The novel High Power Impulse Magnetron Sputtering (HIPIMS) deposition technology has been used to deposit CrN/NbN with enhanced adhesion (critical scratch adhesion value of Lc=80N) and a very dense microstructure as demonstrated by XTEM imaging. These superior coating properties are achieved due to the unique high metal ionization (up to 90%) in the HIPIMS plasma, which allows particle accelerationby external electrical or omagnetic fields thus delivering highly energetic material flux on the condensing surface.
P92 bare and coated samples were oxidised at 650 ºC in 100% stem atmosphere up to 2000 hours using a spcialised testing rigin order to stimulate the future operation conditions of steam turbines employed in power plants.The oxidation kinetics was evaluated by mass gain measurements. In these conditions CrN/NbN provided reliable protection of the P92 steel. The paper also discusses the effect of growth defects and high temperature crack formation analysed by SEM and FIB-SEM techniques on the high temperature corrosion resistance in pure steam atmosphere thus revealing both the coatng failure and protection mechanisms.

Keywords
HIPMS
Corrsion
stem
turbines
nanostructure