

The Chemical Transport Mechanism of Emitter Micro-Particles in Tungsten Electrode: A Metallurgical Study

Authors : G. Singh, H.Schuster, U. Füssel

Abstract : The stability of electric arc and durability of electrode tip used in Tungsten Inert Gas (TIG) welding demand a metallurgical study about the chemical transport mechanism of emitter oxide particles in tungsten electrode during its real welding conditions. The tungsten electrodes doped with emitter oxides of rare earth oxides such as La_2O_3 , Th_2O_3 , Y_2O_3 , CeO_2 and ZrO_2 feature a comparatively lower work function than tungsten and thus have superior emission characteristics due to lesser surface temperature of the cathode. The local change in concentration of these emitter particles in tungsten electrode due to high temperature diffusion (chemical transport) can change its functional properties like electrode temperature, work function, electron emission, and stability of the electrode tip shape. The resulting increment in tip surface temperature results in the electrode material loss. It was also observed that the tungsten recrystallizes to large grains at high temperature. When the shape of grain boundaries are granular in shape, the intergranular diffusion of oxide emitter particles takes more time to reach the electrode surface. In the experimental work, the microstructure of the used electrode's tip surface will be studied by scanning electron microscope and reflective X-ray technique in order to gauge the extent of the diffusion and chemical reaction of emitter particles. Besides, a simulated model is proposed to explain the effect of oxide particles diffusion on the electrode's microstructure, electron emission characteristics, and electrode tip erosion. This model suggests metallurgical modifications in tungsten electrode to enhance its erosion resistance.

Keywords : rare-earth emitter particles, temperature-dependent diffusion, TIG welding, Tungsten electrode

Conference Title : ICWET 2018 : International Conference on Welding Engineering and Technology

Conference Location : Paris, France

Conference Dates : September 20-21, 2018