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Wetting and interfacial microstructure of porous $\text{Si}_3\text{N}_4/\text{Si}_3\text{N}_4$ joint after silver metallization

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ABSTRACT

In order to improve the wettability of Ag–Cu–Ti filler on porous Si_3N_4 ceramic, a surface silver metalized modification of porous Si_3N_4 ceramic was achieved by the methods of immersion with AgNO_3 solution and subsequent thermal decomposition processing. Then, the porous $\text{Si}_3\text{N}_4/\text{Si}_3\text{N}_4$ joint was brazed with Ag–Cu–Ti filler at 880°C for 10 min. Effect of silver metallization on the wettability and interface microstructure of joint were investigated in detail. After silver metallization, SEM results revealed that a large number of spherical silver particles were uniformly distributed on the surface of Si_3N_4 grains. The contact angle of filler on porous Si_3N_4 ceramic was changed from $\sim 8^\circ$ to $\sim 6^\circ$ after metallization; meanwhile, the filler infiltrated into the pores of ceramic surface with the thickness from ~ 25 to $\sim 45\ \mu\text{m}$, which implied that silver metallization could promote filler into the pores of ceramic surface. The different morphologies of interface were also found in the process of brazing. It was observed that the joint without pre-silver-metallization exhibited single face infiltration with the layer thickness of $\sim 25\ \mu\text{m}$ under the action of gravity, while both faces were infiltrated with the layer thickness of $\sim 60\ \mu\text{m}$ after metallization. SEM results discovered that an ideal “ceramic parent material – infiltration layer – welding seam – infiltration layer – ceramic parent material” gradient structure of porous $\text{Si}_3\text{N}_4/\text{Si}_3\text{N}_4$ joint was obtained by using this method. In addition, the shear strength of the porous $\text{Si}_3\text{N}_4/\text{Si}_3\text{N}_4$ joint was significantly improved by metallization.

KEYWORDS: porous Si_3N_4 , silver metallization, wetting, interface