High Temperature Oxidation and Corrosion of Silicon Nitride Ceramics in Air, Water Vapour, SO_2 and HCl Environments

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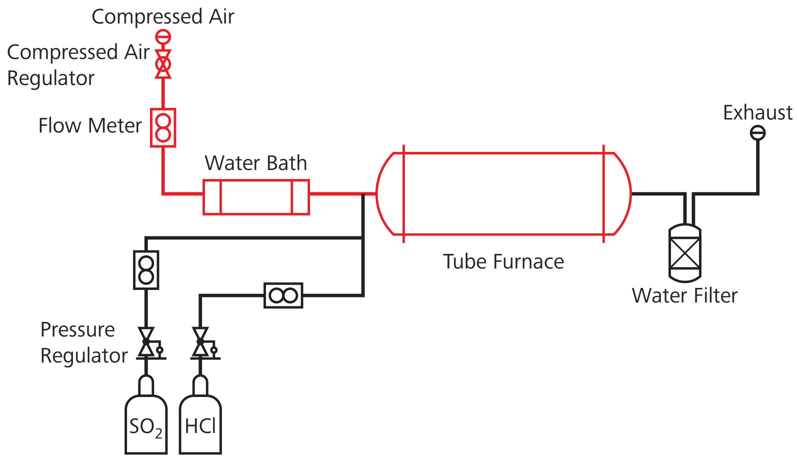
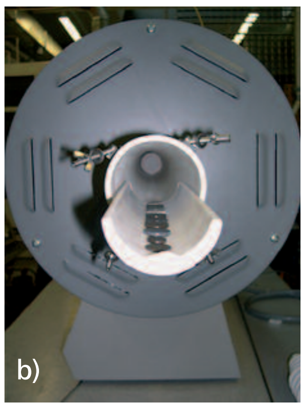
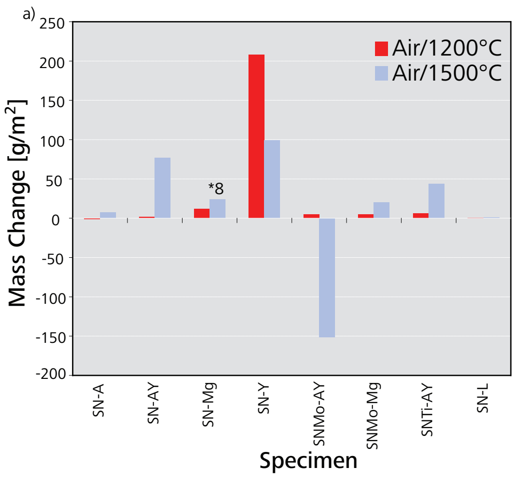
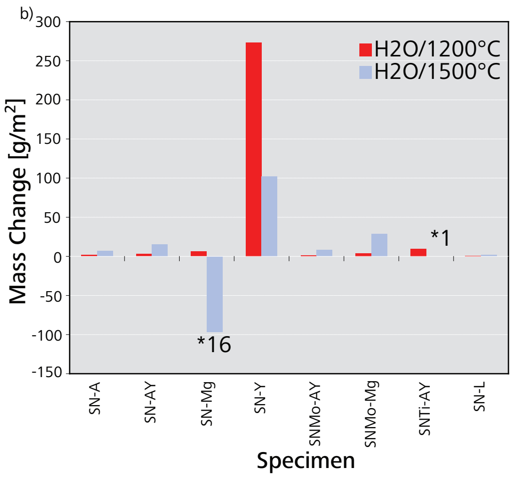
Si_3N_4 based ceramic composites (Si_3N_4, Si_3N_4/TiN, and Si_3N_4/$MoSi_2$) densified with different sintering additives were tested for high corrosion resistance. Tests were carried out in different environments; air, water vapour, SO_2 and HCl.

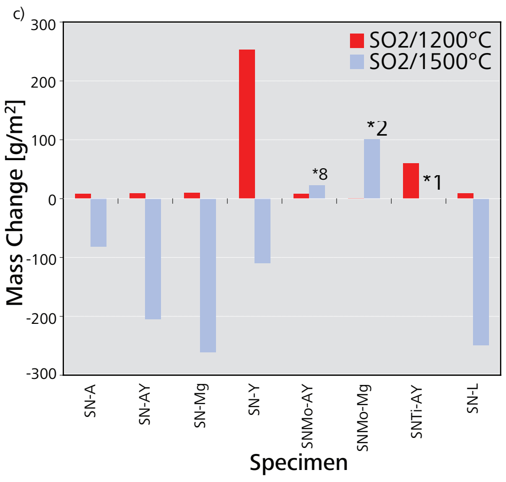


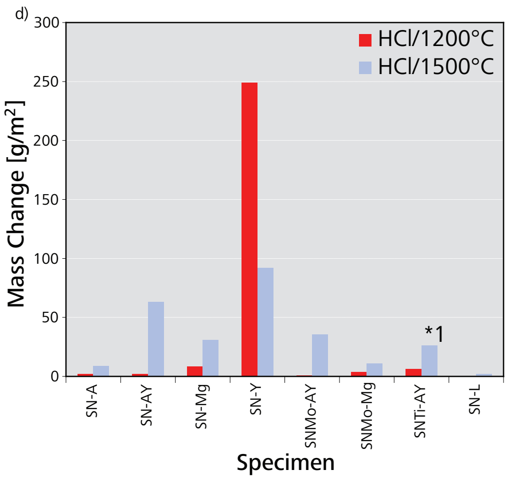


The mass change as a function of exposure time up to 128 h was measured. The materials have been produced using the following sintering additives: A-aluminium oxide, Mg-magnesium oxide, AY-aluminium oxide and yttrium oxide, Y-yttrium oxide and L-lutetium oxide (SN = Si_3N_4). These sintering additives play a critical role on high temperature properties including corrosion and oxidation.

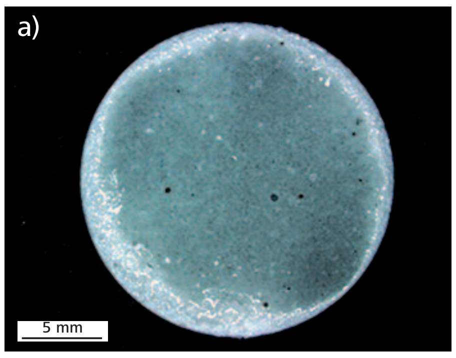


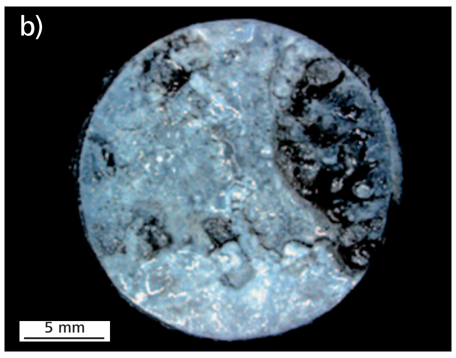


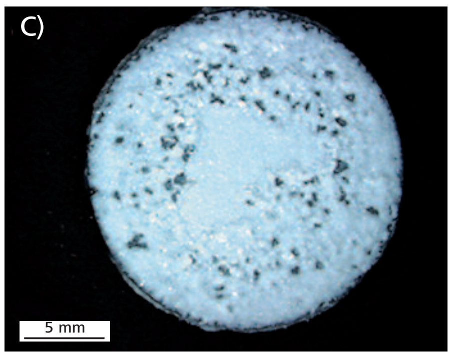


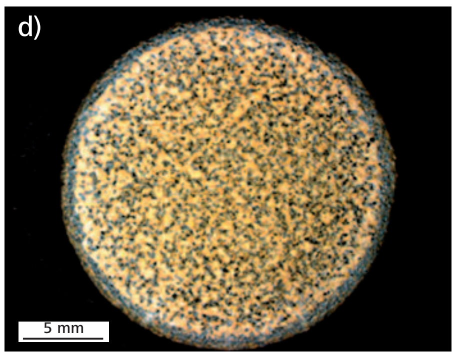


Discs of different composition show different damage after oxidation and corrosion for example at 1500°C in water vapour and after 128 h (a) SN-A has an amorphous SiO_2 surface layer on the disc, (b) SN-Mg has glass with gas bubbles, (c) SNMo-Mg has glass crystals and (d) SNTi-AY has yellow TiO_2.

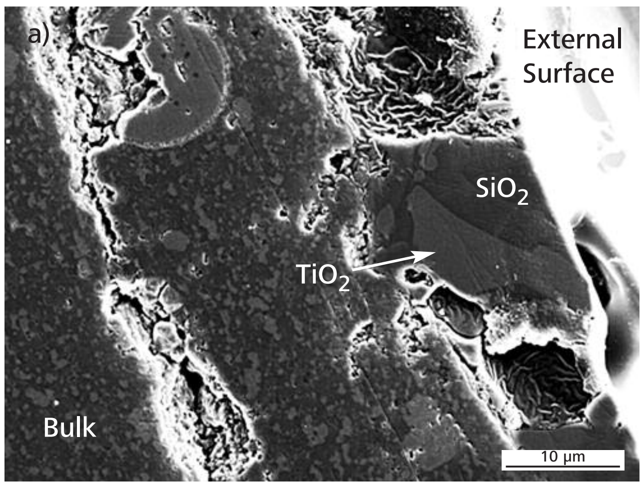


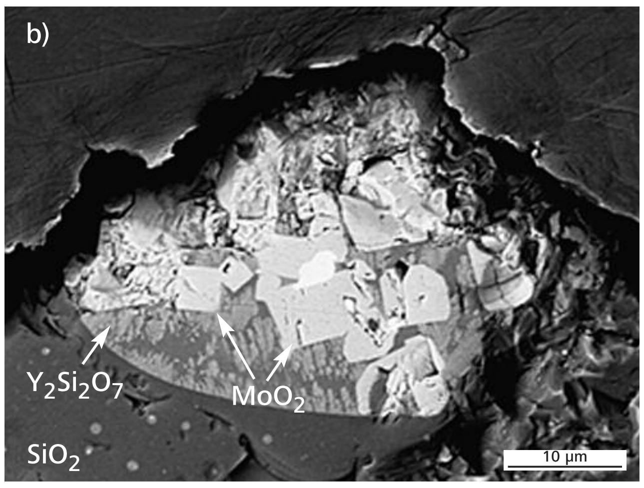


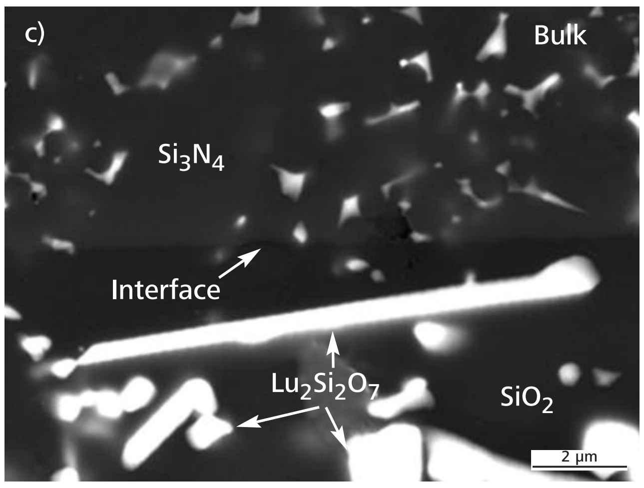




Exposure to oxidation and corrosion leads to the formation of a passive SiO_2 layer in the early stages. Further degradation is by diffusion of the environment through this layer. SEM studies showed the different corrosion products TiO_2 and SiO_2 in the Si_3N_4/TiN-AY composites, MoO_2, SiO_2 and Y_2Si_2O7 in the Si_3N_4/$MoSi_2$-AY composites and $Lu_2Si_2O_7$ and SiO_2 in the Si_3N_4-L material.







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