Investigation into Combustion Characteristics of Fuels (Renewable), to Aid Material Selection and Design of Novel SSiC/ SiSiC Ceramic Heat Exchangers

Sokesimbone Ncube

In recent years - fuels i.e. Biomass, Refuse Derived Fuels as alternatives to fossil based fuels like coal are being applied as energy sources in high temperature processes. In the optimization of these processes (e.g. power plant), heat from flue gases is recovered through heat exchangers. The construction materials have been based on metallic alloy compounds. Biomass fuels contain components like chlorine, potassium which react to form salts and deposit on heat exchanger surfaces - depending on temperature and pressure conditions during combustion. The diffusion of the salts (KCl, NaCl) effectively leads to corrosion as the metal surfaces react with the chlorine. In the long term the surfaces of the heat exchangers are damaged and require replacement. Ceramic based materials (SSiC, SiSiC) on the hand exhibit features like high thermal conductivity, chemical/thermal stability, lightweight etc. and hence applicable as materials for construction for heat exchangers. Prior to their construction in application areas e.g. Biomass Fired plants - substantial information is still required in their long term stability under corrosive atmospheres.

The main focus of the research is based on investigations on the influence of fuel properties, flue gas components and particle deposition on the applied SSiC/SiSiC ceramic materials. From the information the design and construction of ceramic heat exchangers can be optimized. Examples include ceramic heat pipes which as heat recovery units can be applied in wide temperature range and operating atmospheres.