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Effects of electron beam radiation doses on the foam formation in pre-ceramic polymer

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Methylsilicone resin as a polymer precursor for a SiOC ceramic material was cured and foamed by electron beam (EB) irradiation in air prior to the pyrolysis under an inert atmosphere. Methylsilicone foams were obtained without

additional foaming agent when exposed to accelerated electrons with radiation doses up to 9 MGy and dose rate of 2.8 kGy/s. During irradiation the polymer was melted and simultaneously gaseous products were formed by the polycondensation crosslinking reactions. The formed gases could not escape from the molten polymer and began to aggregate into bubbles. The effect of the radiation dose on the polymer foam molecular structure, the gel fraction and the ceramic yield was analyzed. The results indicate that the maximum amount of crosslinking in methylsilicone, when EB radiation was used, occurred between 1.0 and 3.5 MGy radiation doses. Methylsilicone foams were pyrolysed in inert atmosphere at temperatures of 1200 °C and 1500 °C, resulting in amorphous SiOC and partially crystalline ceramic foams, respectively. A porosity of ~ 84 % was achieved in the pyrolyzed foams, with cell size ranging from 30-300 μm and bulk density of about 0.31 g/cm^3.

Keywords: electron beam curing, irradiation, silicon oxycarbide, methylsilicone, ceramic foam.