142ak The Effect of Filler and Diamine Size on the Fracture Toughness of Alumina Reinforced Epoxy Composites

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The stress intensity factor, K_{Ic}, was used to quantify the fracture toughness of novel epoxy alumina (Al_2O_3) reinforced composites based on bisphenol A diglycidyl ether (DGEBA) and diamines with a poly(propylene oxide) (PPO) backbone. Such epoxy composites are very useful in industry due to their excellent mechanical properties and chemical resistance. However, their brittleness often leads to crack propagation and specimen failure. Herein we present the effect of the variation of the particle size diameters (2, 5, 10, 18 and 26 μm), particle size distribution and inter-crosslink distance (PPO spacer lengths of M_n = 230, 400 and 2000) on the fracture toughness. The K_{Ic} increased with an increase in Al_2O_3 volume fraction for all particle sizes and distributions tested and typically doubled at 50% (v/v) Al_2O_3. With the exception of DGEBA-230/18μm-Al_2O_3, the larger PPO spacers resulted in higher fracture toughness of the unfilled epoxy but decreased the incremental toughening effect of the Al_2O_3. The particle sizes did not affect the K_{Ic} values. An unexpected, 6-fold increase in K_{Ic} at 50% Al_2O_3 (v/v) was achieved with the DGEBA-230/18μm-Al_2O_3 system. This promising work increases current understanding of particle and matrix variables.