Effect of matrix modification on interfacial adhesion of glass fibre reinforced poly(vinylidene fluoride) composite

J. Zhao\textsuperscript{1,2,*}, K. K. C. Ho\textsuperscript{1}, S. Shamsuddin\textsuperscript{1}, V. Dutschk\textsuperscript{2}, A. Bismarck\textsuperscript{1}

\textsuperscript{1}\textit{Imperial College London, South Kensington Campus, London SW7 2AZ, UK}
\textsuperscript{2}\textit{University of Twente, Drienerlolaan 5, 7522 NB Enschede, The Netherlands}
\textsuperscript{*e-mail: j.zhao-1@utwente.nl}

Due to the extreme chemical inertness and high thermal stability, fibre reinforced polyvinylidene fluoride (PVDF) composites have great potential for the application of pipelines and vessels. In this study, surface properties of three differently sized glass fibres as well as of a highly non-reactive thermoplastic PVDF modified by maleic anhydride grafted PVDF (MAH-g-PVDF) have been studied. A Wilhelmy method was used to characterise fibre diameter, wettability and surface free energy. In order to understand acidic/basic surface functionalities and the effect of dissociated functional groups on glass fibre surfaces, zeta-potential plateau values and the position of isoelectric points were recorded by the zeta-potential measurement. The results of water contact angles and zeta-potentials for MAH-g-PVDF indicated that the concentration of the dissociated acid groups in the matrix bulk was increased by grafting maleic anhydride, but remained roughly constant on the surface.

A single fibre pull-out technique was used for interfacial adhesion measurements. The results obtained for MAH-g-PVDF were confirmed by the increased apparent interfacial shear strength by 135% and 75% for the acidic and basic surface fibre, respectively. No changes for non-polar surface glass fibre were observed. Therefore, better mechanical properties of composites can be achieved by an improved interaction between polar surface glass fibre and MAH-g-PVDF matrix.