

WETTING DYNAMICS AND ADHESION OF THERMOPLASTIC POLYMERS ON GLASS

Y. Zhang^{1,2}, C. A. Fuentes¹, A. W. Van Vuure¹, J. De Coninck², D. Seveno¹

¹ Department of Materials Engineering, KU Leuven, 3001 Leuven, Belgium

² Laboratory of Surface and Interfacial Physics, Université de Mons, 7000 Mons, Belgium

david.seveno@kuleuven.be

Wetting dynamics drive numerous technological processes involving liquids in contact with solid substrates with a wide range of geometries. The spreading dynamics of organic liquids and liquid metals at, respectively, room temperature and above 1000 °C have been studied extensively, both experimentally and numerically. However, much less attention has been paid to the wetting behavior of molten drops of thermoplastic polymers, despite its importance in the fields of polymer composites, injection moulding, and fused deposition modelling for example. There is even no knowledge about the relevancy of the classical dynamic wetting theories, i.e. the hydrodynamic approach and the molecular-kinetic theory to model the behavior of these complex liquids. This work therefore investigates the spreading dynamics of three polymers, polypropylene (PP), maleic anhydride-grafted polypropylene (MAPP), and polyvinylidene fluoride (PVDF) on glass slides, at temperatures ranging between 200°C and 260°C. These polymers were chosen based on the fact that they have different physico-chemical interactions with this substrate. The PP/glass substrate interaction should be dominated by van der Waals interaction. In the case of PVDF, additionally to the van der Waals forces, many hydrogen bonds can be created between PVDF and the OH groups on the substrate, owing to the electronegativity of the fluorine group. In addition to physical interactions, MAPP has the capability to form chemical bonds with glass via the reaction between maleic anhydride (MA) groups and OH groups presented on the glass surface [1], [2]. These measurements are completed by experiments performed with mixtures of PDMS oils of different viscosities acting as prototypes of the polymers. The study emphasizes the complex wetting behavior of these liquids controlled at the same time by the surface topography and the possible segregation of short polymer chains at the contact-line[3], [4].

REFERENCES

- [1] Y. Zhang, C. A. Fuentes, R. Koekoekx, C. Clasen, A. W. Van Vuure, J. De Coninck, and D. Seveno, "Spreading Dynamics of Molten Polymer Drops on Glass Substrates," *Langmuir*, **2017**, 33, 8447–8454.
- [2] C. A. Fuentes, Y. Zhang, H. Guo, W. Woigk, K. Masania, C. Dransfeld, J. De Coninck, C. Dupont-Gillain, D. Seveno, and A. W. Van Vuure, "Predicting the adhesion strength of thermoplastic/glass interfaces from wetting measurements," *Colloids Surfaces A Physicochem. Eng. Asp.*, **2018**, 558, 280–290.
- [3] Y. Zhang, A. Vandaele, D. Seveno, and J. De Coninck, "Wetting dynamics of polydimethylsiloxane mixtures on a poly(ethylene terephthalate) fiber," *J. Colloid Interface Sci.*, **2018**, 525, 243–250.
- [4] Y. Zhang, S. Moins, O. Coulembier, D. Seveno, and J. De Coninck, "Capillary rise of polydimethylsiloxane around a poly(ethylene terephthalate) fiber versus viscosity: Existence of a sharp transition in the dynamic wetting behavior," *J. Colloid Interface Sci.*, **2019**, 536, 499–506.