Adsorbed Polystyrene Chains at Interface Probed by Sum Frequency Generation Vibrational Spectroscopy

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Abstract: When polymer chains are adsorbed onto weakly attractive surfaces, the adsorption state can easily be changed, leading to weakly and strongly adsorbed cases with different chain conformations. In the extreme case for strongly adsorbed polymer chains, an irreversibly adsorbed layer (or Guiselin layer) could be formed (Europhys. Lett., 1992, 17, 225-230). We applied sum frequency generation (SFG) vibrational spectroscopy to probe polystyrene (PS) chains adsorbed onto sapphire surfaces perturbed with good solvent (carbon tetrachloride, CCl_4) and nonsolvent (deuterated water, D_2O). In the weakly adsorbed case, good solvent and nonsolvent can substantially change the conformation of the adsorbed PS chains at the interface; while in the strongly adsorbed case, good solvent and nonsolvent can not change the conformation of the adsorbed PS chain at the interface. This experimental study proves that the weakly adsorbed PS chains show flexibility and the strongly adsorbed PS chains show rigidity with respect to the sapphire surface. Extension of this study using SFG will further be presented, leading to probing and understanding evolution of PS chains at the buried interface - the local structural evolution of the adsorbed PS chains can significantly promote the dewetting of the PS film on top.

Keywords: SFG, adsorbed chains, PS, interface, dewetting