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UPS investigation of ethylbenzene, styrene and water in adsorption-desorption equilibrium on Pt(111) and on epitaxial FeO(111) and Fe_3O_4(111) films

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UPS as a non-destructive method was used to study the adsorption of ethylbenzene (EB), styrene and water on Pt(111) and on FeO(111) and Fe_3O_4(111) films at constant gas pressures and different temperature. Adsorbate induced emission and substrate attenuation were used to determine the coverage. Isosteric heats of adsorption q_{st} were deduced from measured isobars $\Theta(T)_{p=const}$. On the oxides, adsorption of EB is molecular. On Fe_3O_4 it chemisorbs in the first layer ($q_{st}\geq 80$ kJ/mol), followed by a physisorbed second layer (q_{st}=55 - 70 kJ/mol) and condensation from the third layer on ($q_{st}\cong 50$ kJ/mol). On FeO the chemisorbed phase is missing. Water dissociates in the first layer on Fe_3O_4 whereas it does not on FeO. Since FeO is oxygen terminated whereas Fe_3O_4 contains ¼ ML of Fe in the top layer, we attribute chemisorption of EB and dissociation of water to interaction with these iron atoms. On Pt, EB dissociates and forms tightly bound styrene in the first layer. Also here, a physisorbed second layer of EB and finally condensation is observed. From the strong modification of the molecular π orbital emission features we conclude that the phenyl rings of EB chemisorbed on Fe_3O_4 and of styrene chemisorbed on Pt are oriented parallel to the surface.