Potential Dependant Sum Frequency Generation
Study of 5-methylbenzotriazole on
Polycrystalline Copper, Platinum, Gold, and
Cu(111)

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In-situ Sum Frequency Generation (SFG) vibrational spectroscopy, at varied potentials and polarization combinations, was performed on polycrystalline and single crystal (111) copper, polycrystalline platinum, and polycrystalline gold samples in 0.5 M HClO4 with 50mM 5-methylbenzotriazole (5-methylBTAH) added. These studies were performed in order to determine the orientation of the molecule on the surface at different potentials. Spectra on copper show antisymmetric methyl peaks at 2920 cm⁻¹ and at 2960 cm⁻¹ and a C-H aromatic peak at 3050 cm⁻¹. For copper surfaces, orientation of the molecule on the surface is not affected by potential within the potential window studied (-500mV to -100mV vs. SCE). Since the spectra do not show the methyl symmetric peak (2875 cm⁻¹), it suggests that the molecule is lying with the aromatic ring parallel to the copper surface. SFG Spectra of 5-methylBTAH on platinum shows a change in orientation over the potential range studied (-250mV to 750mV vs. SCE). This orientation change is correlated to hydrogen adsorption on the platinum surface or from the difference in the potential at zero charge of the two electrodes. 5-methylBTAH did not orient on gold at negative potentials but began to orient at more positive potentials over the potential range studied (-500mV to 900mV vs. SCE). To compliment these results, cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) measurements were performed. Cyclic voltammograms of copper show that addition of 5-methylBTAH protects the surface from copper dissolution for several hundred millivolts, thus increasing the range of the electrochemical window. CV of 5-methylBTAH on platinum showed a partial blockage of adsorbed hydrogen and a complete blockage of adsorbed perchlorate ion. CV on gold shows that 5-methylBTAH blocks oxide adsorption for several hundred millivolts. EIS has been performed to determine the potential of zero charge of the different systems and to examine the corrosion inhibition efficiency of 5-methylBTAH on copper.