Contact Charging Studies of Single Crystal Insulators

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***Abstract*— The exact mechanism behind contact charging between insulators still remains unknown. Investigating this is difficult because insulating materials are often heterogeneous, lacking long range order and chemical uniformity. Here, we studied contact charging of single crystal insulators that have well-defined crystal and chemical structure such as aluminum oxide (sapphire), silicon oxide (quartz), and magnesium oxide (periclase). Substrates were held by a vacuum pick setup and contacted in air, with humidity 5-20% RH, by vigorous rubbing to promote a saturation charge. The surface charge was then measured by a Faraday pail connected to a Keithley 6517A Electrometer. For charging experiments involving sapphire and quartz, we found that the quartz charged negatively and sapphire charged positively with an average surface charge of 11.5 μC/m2 and -8.7 μC/m2 respectively. Periclase was found to charge negatively when contacted with sapphire and positively when contacted with quartz with a surface charge of -6.9 μC/m2 and 7.5 μC/m2, respectively. To assess the role of material transfer, contacted surfaces were characterized by X-ray photoelectron spectroscopy. Survey spectra indicated that silicon was transferred onto the sapphire surfaces but aluminium did not transfer onto the quartz surfaces. This is expected based on the sapphire's superior hardness as compared to quartz. Overall, the single crystal substrates provide a controlled material to relate charging of insulators in both experiments and computer modeling.**