

Triboelectric Charging Studies of Single Crystal Insulators

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Abstract — The mechanisms driving triboelectric charging between insulators still remains a mystery. A simple question as “If material A contacted with a different material B, which material would charge positively or negatively?” is a difficult question 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) and silicon oxide (quartz). Experimentally, substrates were temporarily glued to wood dowels and contacted in a glovebox air at specific humidities, ranging from 5% to 95% RH. Saturation charge was promoted by vigorous rubbing and 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 always charged negatively and sapphire always charged positively for all the humidities tested with higher net charge magnitudes measured at drier humidities than wet humidities. Overall, the single crystal substrates provide a controlled material to relate charging of insulators of different chemical composition in both experiments and computer modeling.