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Comparison of Polymer Etching Mechanisms by Cold Atmospheric Plasma (CAP) Sources Under Well-Defined Conditions ANDREW KNOLL, PINGSHAN LUAN, ADAM PRANDA, GOTTLIEB OEHRLEIN[1], University of Maryland College Park — Cold atmospheric plasma sources are important sources of reactive chemical species that can used to deactivate bacteria and biomolecules or modify surfaces under mild conditions, leading to use in numerous applications. We examine varying substrate temperature on polymer etching using an atmospheric pressure plasma jet (APPJ) and a surface microdischarge (SMD) source. The APPJ shows high etch rates but mild surface modification whereas the SMD shows no etching at room temperature but significant surface modification. An Arrhenius equation is used to fit the temperature dependence of etch rate and yields apparent activation energies. APPJ treatment activation energy increases as a function of distance from 0.2 eV up to 0.5 eV. The activation energy of the SMD source is significantly higher than the APPJ at 0.8-0.9 eV and overall causes less etching. The directionality of etching is investigated using patterned samples. APPJ etching has anisotropy which becomes more isotropic with increasing treatment distance where the SMD has only isotropic etching. APPJ induced etching of these polymers must include other reactive species than neutral species alone, potentially line-of-sight charged particles, that enhance the rate of chemical etching. SMD etching is consistent with neutral chemical etching only, highlighting key differences between these two sources. The authors gratefully acknowledge financial support by US Department of Energy (DE-SC0001939) and National Science Foundation (PHY-1415353).

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