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Plasma discharge drilling for deep subsurface access to Mars' polar layered deposits[1] XIN TANG, JACOB MALLAMS, KUNPENG WANG, CHRISTOPHER CAMPBELL, CAMERON ADKINS, TYLER BARNES, DAVID STAACK, Texas A&M University, GARETH MEIRION-GRIFFITH, FERNANDO MIER-HICKS, DAN GOEBEL, DANIEL LEVINE, WILLIAM REID, NASA Jet Propulsion Laboratory, KRIS ZACNY, Honeybee Robotics, Ltd — Mars' polar layered deposits (PLD) contain the best historical record of the Amazonian time period. Compositional measurements of isotopes, volatiles, and dust trapped between PLD strata are essential to understanding Mars' climate evolution. Deep subsurface access at Mars' poles is challenging, however, due to the unique environmental conditions. Traditional mechanical drilling methods relying on in situ cutting fluids are likely infeasible; neither CO_2 nor H_2O are phase-stable under polar ambient conditions. Hot-tip melt-probes, an alternate to mechanical drills, are highly inefficient due to conductive losses. This work summarizes an investigation into the potential of plasma discharge drilling to enable efficient access to the polar subsurface. The approach enables rapid thermal shocking of the ice, producing fractures and reduced thermal conductivity. A glow discharge then penetrates the ice-CO_2 mix, yielding the requisite melting/sublimation. The results of proof-of-concept tests performed under both Earth and Mars ambient conditions are discussed, along with the design of the experimental system and sample preparation. Experimental results are compared with those obtained from a simplified heat conduction model in COMSOL.

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