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Plasma pulse rock drilling to induce micro-cracks for reduced cutting energy and increased rate of penetration MIRZA AKHTER, JACOB MALLAMS, XIN TANG, AAMER KAZI, YI-TANG KAO, SANAT KUMAR, BRUCE TAI, DION ANTAO, ALAN PALAZOLLO, DAVID STAACK, Texas AM University — Underwater plasma can generate intense shock waves, which when impacted on a brittle surface induce microcracks. The effect of the plasma discharge on the surface depends on plasma pulse energy, electrode gap spacing, and electrode substrate spacing. The microcracks generated on the surface can reduce the strength of the material. This could be useful in rock drilling applications where there is a need of higher rate of penetration and reduced operational downtime. Preliminary results with shockwave plasma pulse drilling under atmospheric conditions were promising. Nano-second plasma pulses in liquid were used to induce microcracks on rock surface. A parametric study on plasma energy per pulse vs number of discharges and induced cracks on surface was carried out. Effects of electrode gap spacing and electrode substrate spacing were studied at atmospheric conditions. To simulate downhole pressure conditions a pressure vessel capable of 5000 psi was built. Initial tests show that an increasingly smaller electrode gap is required for a plasma discharge to occur at elevated pressures. The reduction in cutting energy due to microcracks is yet to be explored but overall results show that plasma pulse drilling may be beneficial in the drilling process.

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