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Non-random Crack Opening in Partially-Confined, Thermally-Damaged PBX 9501 and Observations on its Effects on Combustion GARY PARKER, BLAINE ASAY, PETER DICKSON, PHILIP RAE, AXINTE IONITA, Los Alamos National Laboratory — During thermal insult to PBX 9501, damage in the form of cracking has been shown to modify the combustion mode and violence after ignition, since flames can intrude at lower pressures through cracks than the more tortuous matrix porosity. However, for fluid transport processes, including volumetric combustion and gas permeation, to occur the porosity must be open and accessible to the surfaces of the charge. Because many charges are encased (confined), there are mechanical limitations on the extent to which thermally-induced cracks can open, therefore diminishing their effect on transport to some concomitant extent. In this work, we present evidence for how strong radial confinement can result in aligned crack opening, despite the existence of plentiful randomly-oriented, though apparently closed, cracks. We damage cylinders in tight-fitting glass or metal sleeves open on both ends and observe the occurrence of preferential crack-opening normal to the cylindrical axis. This geometry and confinement is common in experimental arrangements such as strand burners and DDT tubes. Further, we observe, with high speed photography, how this non-random crack opening affects combustion and propose a mechanism, garnered from linear elastic finite element modeling, for why it occurs.

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