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Experimental investigation of solid fuel smoldering using 3D X-ray computed tomography with gas-phase temperature measurements.[1]
EMERIC BOIGNE, MATTHIAS IHME, Stanford University — Smoldering is a regime of combustion that is characterized by low temperatures, slow rates of fuel consumption, and the absence of a flame. Recent research investigations on smoldering have focused on applications within confined environments such as peat fires, subsurface wildfires, and remediation of soil contamination. The present work reports on the use of 3D X-ray computed tomography to experimentally investigate smoldering in confined configurations. By temporally resolving the surface recession of solid fuel materials, the local consumption rates are extracted at the submillimeter scale. By diluting the ambient flow with Krypton, an inert X-ray tracer, the X-ray measurements enable simultaneous estimations of the 3D gas-phase temperature field. First, a configuration within an over-ventilated environment is considered for validation. Then, more complex fuel-configurations are examined, exhibiting spatial fuel heterogeneities and different fuel materials. Effects of the spatial heterogeneities on the smoldering process are discussed using the temporally-resolved 3D measurements. The simultaneous measurements of local consumption rate and gas-phase temperature allow further investigations of state-of-the-art models of smoldering.

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Emeric Boigne
Stanford University

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