Existence of Weak Zones: Enhancing Dynamic Rupture or Not?

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Existence of a mechanically weak zone such as a geological fault plane is quite often considered to enhance or promote propagation of dynamic rupture in a brittle solid. Indeed, extraordinarily accelerated high-speed ruptures and ensuing asymmetric seismic motion and structural failures due to the presence of large-scale fault planes have been indicated experimentally as well as numerically (e.g. Uenishi et al., *BSSA*, 1999; Uenishi, *Eng. Fail. Analysis*, 2015). However, for instance, as pointed out by Uenishi (*Proc. Mat. Sci.*, 2014), deflection or bifurcation of rupture propagation at another typical weak zone, namely, at an interface of a layered medium, is not usually taken into account in seismological studies, and it is not certain at all whether the existence of a weak zone really promotes seismic rupture propagation or not.

Therefore, in this study, by continuing our investigation into rupture development in a brittle solid that contains weak zones or sets of small-scale parallel cracks in certain areas (Uenishi et al., *SSJ Fall Meeting*, 2017, 2018, 2019; Uenishi and Nagasawa, *SSJ Fall Meeting*, 2020), we examine the effects of positions, density and individual length of the small-scale cracks. As before, using a digitally controlled laser cutter, we prepare rectangular photoelastic polycarbonate specimens with small-scale cracks that are parallel to each other and have some dip angle. Each specimen is externally loaded by a tensile testing machine quasi-statically at a constant strain rate.

Our experimental observations using a high-speed digital video camera show that weak zones do not always promote propagation of primary rupture and they can rather arrest and "absorb" rupture propagation itself. Furthermore, the experimentally obtained snapshots indicate that a sudden spatial change of crack density in a weak zone can mechanically serve as a large-scale plane of weakness. We also illustrate that the length of each crack plays a decisive role in rupture development in and around a weak zone.

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