Stick-slip crack growth instability in adhesive tapes

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We study experimentally the fracture dynamics during the peeling at a constant velocity of an adhesive tape. An original peeling setup which we have developed allows to peel the adhesive from a plane substrate while setting the mean peeling angle to a constant value. This experimental achievement is made possible by the coupled motions of the substrate and of the peeled tape end at identical velocities thanks to two electronically enslaved motors. Thanks to a high speed camera, we measure, in an intermediate range of peeling velocities, high frequency oscillations between phases of slow and rapid propagation of the peeling fracture. This so-called stick-slip regime is well known as the consequence of a decreasing fracture energy of the adhesive in a certain range of peeling velocity coupled to the elasticity of the peeled tape. We are able to access directly the peeling point dynamics and to study quantitatively the Stick-Slip features (Stick and Slip periods and velocities) as a function of the three control parameter which are relevant to the problem : the mean peeled tape length, the mean peeling velocity and peeling angle. We report various Stick-Slip peeling regimes depending on the imposed peeling velocity with periods of Stick and Slip either independent or proportional to V. In these experiments, controlling the peeling angle is a major improvement to understand the physics of adhesive peeling which is confirmed to be strongly dependent on the peeling angle, especially in the Stick-Slip regime. This general feature questions the validity of the usually admitted independence with the peeling angle of the fracture energy of adhesives.