Many critical tasks in robotics, such as locomotion or manipulation, involve collisions between a rigid body and the environment or between multiple bodies. Methods based on sums-of-squares (SOS) for numerical computation of Lyapunov certificates are a powerful tool for analyzing the stability of continuous nonlinear systems, and can additionally be used to automatically synthesize stabilizing feedback controllers. Here, we present a method for applying sums-of-squares verification to rigid bodies with Coulomb friction undergoing discontinuous, inelastic impact events. The proposed algorithm explicitly generates Lyapunov certificates for stability, positive invariance, and safety over admissible (non-penetrating) states and contact forces. We leverage the complementarity formulation of contact, which naturally generates the semialgebraic constraints that define this admissible region. The approach is demonstrated on multiple robotics examples, including simple models of a walking robot, a perching aircraft, and control design of a balancing robot.