Temporary Bonding of Thin Substrates for Use in Flexible Display Manufacturing

A. Law, D. Young, A. Brewer, J. Pettit, and J. Moore

DAETEC, LLC, 1227 Flynn Rd., Unit 310, Camarillo, CA 93012, 805-484-5546, jmoore@daetec.com

ABSTRACT

Thin substrate manufacturing is one of the highest growth areas in electronics and represents a fundamental starting point for flexible displays. Current substrate materials can be classified as organic and inorganic. Desired materials and methods are selected in such a manner whereby the thin substrates are temporarily bonded to glass carriers, processed, and released without damage or the need to clean. Daetec's products perform as temporary adhesives or bonding practices exhibiting thermal resistance from a minimum of 300C and extending to ≥600C. Demonstration of temporary bonding of thin glass, foil, and organic films (cast and pre-formed) are prepared.

TEMPORARY BONDING

Current technologies involve a temporary adhesive and a glass carrier to support a thin fragile substrate. The bonded stack includes the glass carrier with adhesive or release layer, onto which, includes the device layer. The processing temperature of the bonded stack is governed by the adhesive and how inert are the exposure conditions. A simple bonded stack description is given in Fig. 1, full process in Fig. 2, and debond by peeling in Fig. 3.

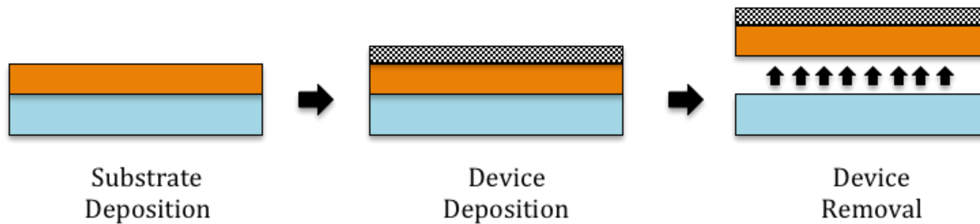

Fig. 1. Description of the bonded stack (left), with device layer (center), and debonding objective (right).

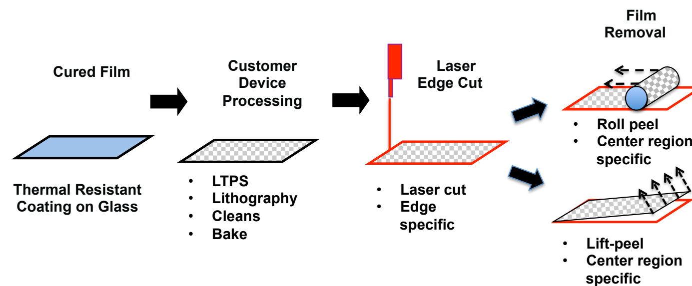

Fig. 2. Example process flow for temporary bonding of thin films in display manufacturing.

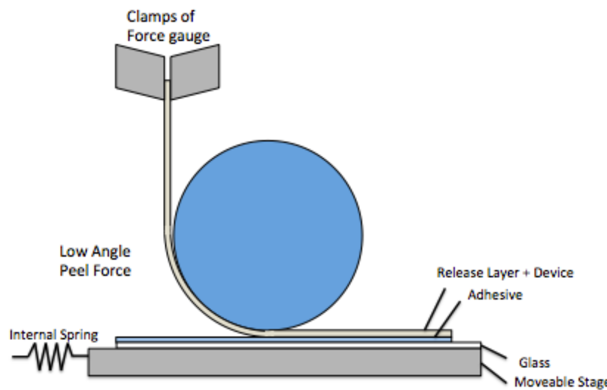

Fig. 3. Peeling Model for removal of device from glass carrier

Debonding thin substrates by peeling can be a simple and reliable practice for manufacturing. Daetec has established standard practices for debonding thin organic films, inorganic foils, and thin glass. The mechanics of setting-up the peel mechanism is dependent on an effective external force that exceeds the material adhesion yet is lower than the product's tensile strength (Fig. 4). This will ensure reliable performance without integrity damage.

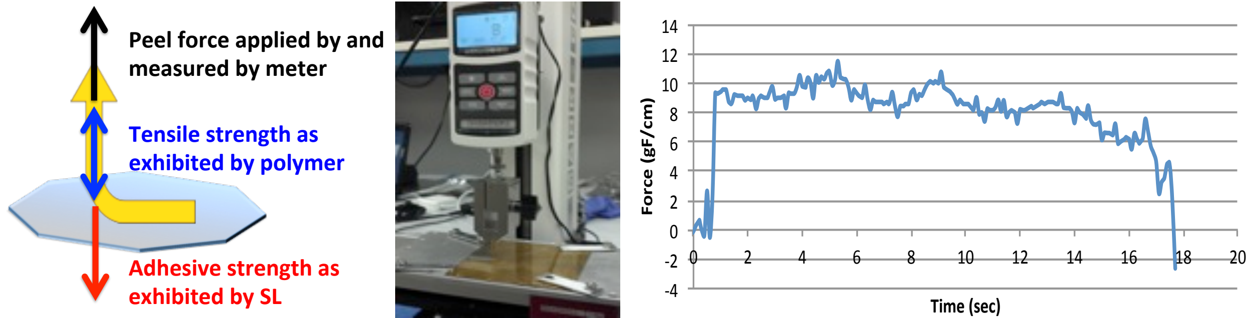

Fig. 4. Peel mechanism model (left) with process and graph of peel force (right).

TEMPORARY BONDING DEMONSTRATION

Daetec's demonstration will include organic and inorganic films (foils) and thin glass. The temporary adhesive chemistry will vary depending upon the form of the thin substrate. When using pre-formed films and thin glass, the adhesive is commonly a viscoelastic polymer. In the case of a cast polymer (e.g. polyimide or alternate), the adhesive form will increase in modulus to allow bonding efficacy. Typical debond force is measured for thin glass and metal foil are given in Fig. 5. Also, a video is submitted for viewing representing Daetec's peeling mechanism for thin glass. Video is included in the submittal (separate cover).

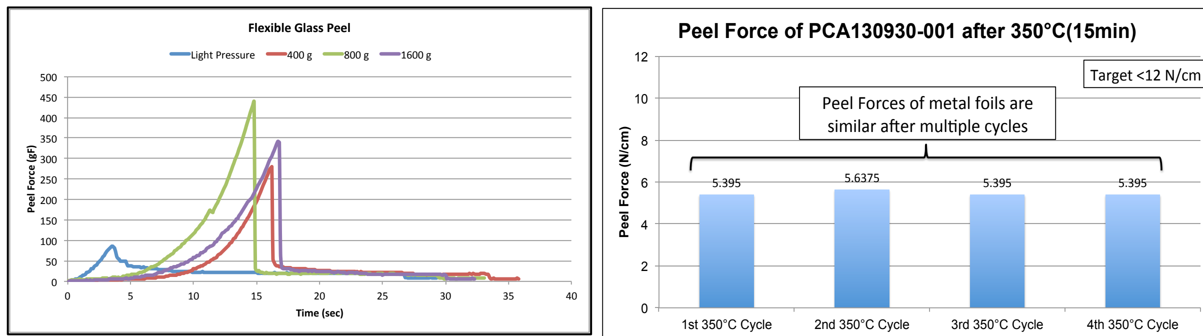

Fig. 5. Peel force measured for thin glass under different bonding pressures (left) and metal foil after temperature cycling up to 4X at 350C (right).

LOGISTICS PLAN

Daetec will bring their peeling tool to the conference with prepared adhesive coated carriers and bonded stack specimens. Adhesive coated carriers are designed for both films and thin glass. The peeling tool with computer interface is used to demonstrate peeling force for each material. Requirements for Daetec's demonstration include power from a normal 115V outlet (2 plugs). All other demo materials and equipment will be provided by Daetec.

DAETEC, LLC 1227 Flynn Rd., Unit 310 Camarillo, CA 93012 805-484-5546
www.daetec.com jmoore@daetec.com