SCRIBING AND CLEAVING CRYSTALLINE AND NON-CRYSTALLINE MATERIALS

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Tool Selection and Practical Tips for Successful Scribing and Cleaving

Scribing is a method of creating an intentional weak point in a substrate in order to force it break at only that location. Cleaving is the act of physically causing the material to break at the created weakness. Successful scribing and cleaving requires knowing what material you are scribing, how it will cleave, and then choosing the best tool for your particular needs.

SPI Supplies offers 3 basic styles of scribing tools, along with various accessories to enhance the cleaving process.

- Pen style scribers (or hand scribers – Fig. 1A) are used like a pen to create a scribe mark on the substrate. These are best used for downsizing large substrates into more manageable pieces, or when high levels of accuracy or precision are not necessary.
    - **Advantages**
        - Quick and easy to use
        - Low cost
        - Variety of diamond angles available
        - Work on any size substrates that can be positioned and held in place
    - **Disadvantages**
        - Low accuracy and precision
        - Requires manual pressure, which could accidentally destroy thin/delicate substrates
        - Touches the top surface of the substrate
        - Can be difficult to create a straight line without using additional tools
- SPI Supplies Precision Glass Cutter (Fig. 1B) is a mid-level scribing tool. Substrates are placed on the steel base, and are scribed with either a silicon carbide or a diamond wheel. These tools are ideal for downsizing materials from as large as 12”-16” (300mm-400mm) down to several cm in size, depending on the substrate thickness.
    - **Advantages**
        - Four sizes available to cover a variety of substrate sizes
        - Variety of scribing wheels available to cover a wide range of substrate types and thicknesses
        - Guide rail ensures a straight scribe every time

        - Magnetic clamping guides available to hold samples in place
        - Offers a good level of accuracy and precision for the price
        - Integrated ruler makes measuring easy
    - **Disadvantages**
        - Requires manual pressure, which could accidentally destroy thin/delicate substrates
        - Touches the top surface of the substrate
        - Without proper care, it is possible to chip the edges of the substrate
        - Uses a wheel rather than a single faceted diamond, which can create a larger scribe mark
- FlipScribe (Fig. 1C) is our highest precision, highest accuracy scribing tool. Unique to this tool is that it scribes the back of the sample, rather than the top surface. It is possible to downsize from as large as 4" (100mm) to as small as 1mm x 1mm with this tool.
    - **Advantages**
        - Scribes from the back, so when combined with the optional sample holders, it is possible to scribe without ever touching the top surface of the sample
        - Integrated ruler allows for accurate sizing measurements with sub-millimeter accuracy
        - Integrated stopper to create short initiation scribes
        - Adjustable, faceted diamond tip makes a very thin scribe line
        - No manual pressure needed, so no risk of breaking delicate samples
    - **Disadvantages**
        - Cannot handle samples larger than 100mm (4")
        - More expensive than our other scribing tools

Fig. 1A – Pen style scribing tool

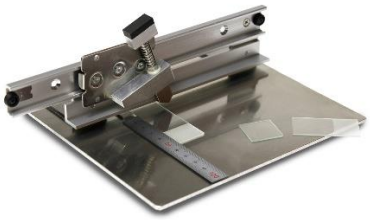

Fig. 1B – Precision Glass Cutter

Fig. 1C – FlipScribe

Scribing and cleaving basics

There are two very basic methods of scribing materials – complete scribes and initiation scribes. Complete scribes are exactly what they sound like. They are a scribe that runs from one end of the substrate to the other (Fig. 1D). When cleaving force is applied to the scribed area, the material will break along the scribe mark. An initiation scribe is a short scribe made at one edge of the substrate (Fig. 1E). When cleaving force is applied to the initiation scribe, it will break following the crystal plane (for crystalline materials) or continue along the weakest points (in a non-crystalline material).

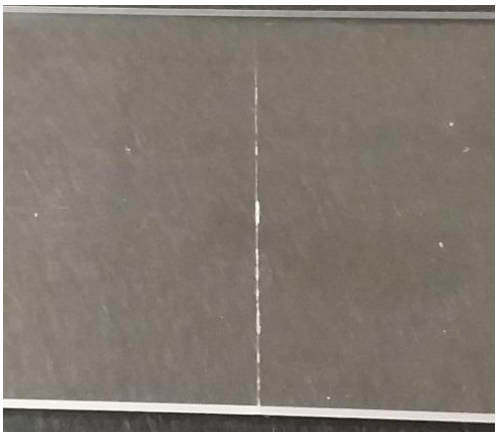

Fig. 1D – Complete scribe in a glass substrate

Fig. 1E – Initiation scribe in a glass substrate

Non-crystalline materials (such as glass slides, coverslips, etc.) are best scored with a complete scribe, and then cleaved along the scribe mark. However, if the goal is to examine the cross section, or to have a defect free edge, it is sometimes better to us an initiation scribe instead. This will give the best edge and cross section possible in the un-scribed region. Due to the amorphous nature of the material, this may not always result in a perfectly straight line break, but will give a natural, defect free edge. (Fig. 1F).

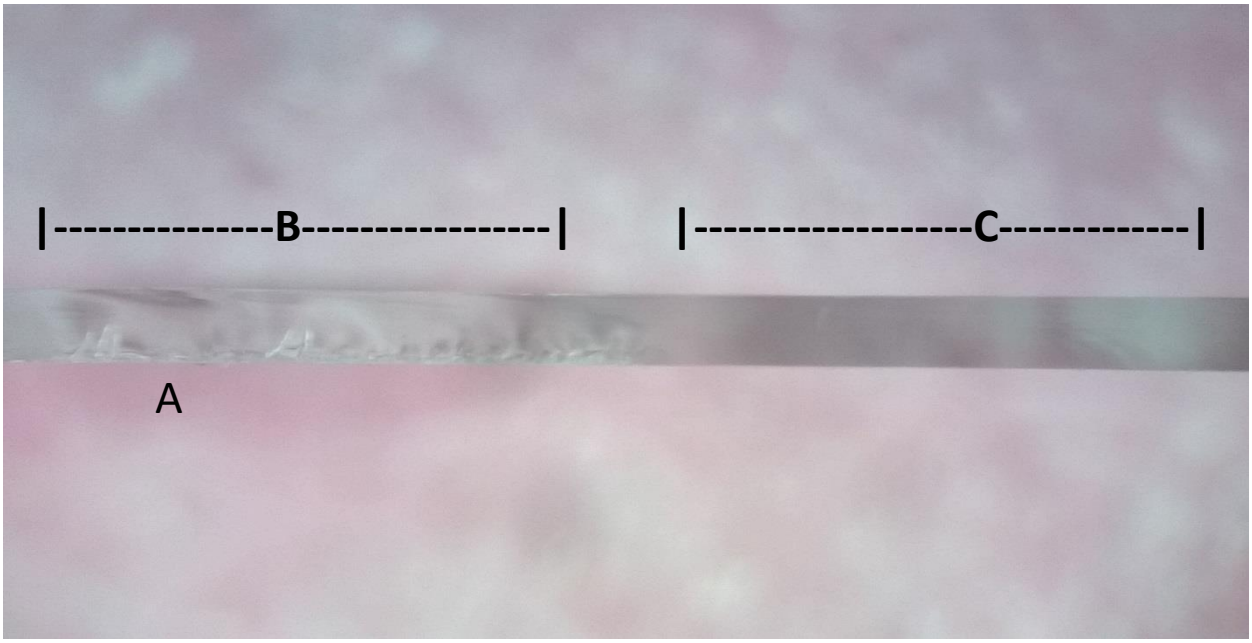

Fig. 1F – Cross section of glass substrate showing: (A) – the side of the substrate where the initiation scribe was placed, (B) the area of the initiation scribe, and (C) the unscribed area where the cleave was allowed to propagate

Crystalline materials (such as silicon based wafers, sapphire wafers, etc.) are best scored with a simple initiation scribe along one of the crystal orientations. The material will then cleave along the natural crystal plane.

Cleaving can be done by hand, but best results are achieved when using cleaving pliers designed for that exact purpose. Typically these are 3-point loading pliers that are designed to exert pressure on the initiation point. Very thick (3-6mm) substrates may require specialized breaking pliers to obtain a clean break. Smaller samples (less than 1") are best handled with smaller pliers that use a modified version of the 3-point load. In all cases, best results are obtained when the pliers are used as close to the edge as possible (Fig 1H).

Fig. 1G – Various types of cleaving pliers

Fig. 1H – It is important when cleaving to grip the substrate as close to the edge as possible to ensure a clean break along the crystal orientation.

It is also important to keep in mind that a shallow, narrow scribe is better than a deep, wide scribe. Wider/ deeper scribe marks can create micro cracks in directions other than the desired cleavage plane. During the cleaving process, they can actually alter the direction of cleavage plane, leading to unsatisfactory results. The shallower and narrower the scribe, the less chance there is of creating these micro cracks.

Should you have any questions regarding tool selection or process, contact our technical staff at support@2spi.com any time.

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