

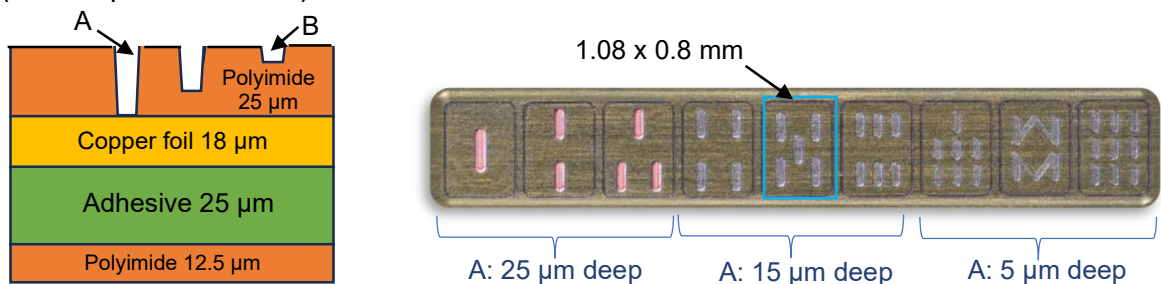
## Micro “Mahjong Tiles” on Composite-multilayer-substrate

### 1. Fine processing with ultrashort pulse laser

Ultrashort pulse laser processing machines (femtosecond and picosecond lasers) can process various kinds of material to make fine grooves, holes, and embossed/debossed shapes on them by the precisely controlled focal point of the laser beam and the orientation of the material.

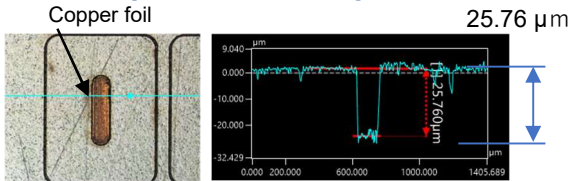
### 2. Pattern formation of micro “mahjong tiles” on a composite-multilayer-substrate

Micro patterns of “mahjong tiles” can be engraved on a substrate of polyimide based FPC (flexible printed circuits).



Cross-section of the FPC (t 80.5 μm)

#### A. Deep groove processing



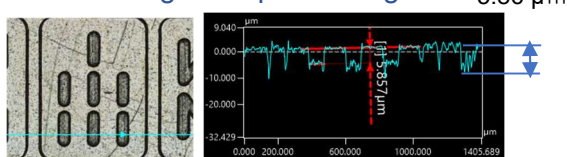
The substrate is processed to expose the copper foil layer. Pattern removal from a FPC is also possible.

#### C. Double-sided hole processing

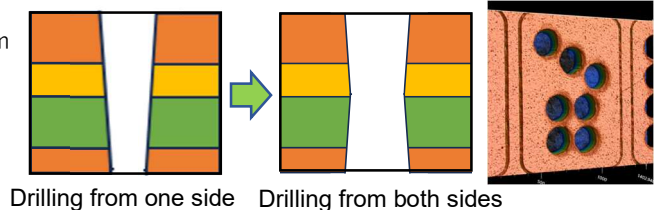


Through-holes were drilled with laser from the both sides of the substrate. This laser-drillings at high positional accuracy can minimize the effect of light collection angle of laser beam.

#### B. Shallow groove processing



Grooves with 5 μm deep are engraved.



Drilling from one side    Drilling from both sides

### 3. Other applications

Polylactic acid (1.5 mm OD)



Laser can process the materials, such as resins as well as metals, without impairing their functions,

SUS304 (1.4 mm OD)



Wires and pipes can be processed into a desired shape by controlling the orientation of the material and the focal point of the laser.

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