Application Note : Flexdym™ Chip Bonding

Assembly & Bonding of Flexdym™ Microfluidic Devices

Bonding.

SUMMARY

This application note describes the bonding of Flexdym™, a proprietary styrenic polymer, developed by Eden Tech. Flexdym™ has mechanical and surface properties which allow it to bond to itself and a variety of other materials, including polystyrene (PS), cyclic olefin copolymer (COC), polycarbonate (PC), poly(methyl methacrylate) (PMMA) and glass. Consequently, Flexdym™ can be useful for various applications ranging from ranging from cell culture to organ-on-chip, diagnosis, etc.

One of the key advantages of using Flexdym™ is its easy and user-friendly bonding method. Unlike most microfabrication materials, it does not involve a time-consuming protocol, expensive equipment, nor any harsh chemical and thermal treatments. Finally, there is no oxygen plasma treatment required, in contrast to PDMS, one of the most popular materials currently used for microfluidics prototyping.

The Flexdym™ material bonds to its substrate directly on contact. This procedure may be performed at room temperature, or with heat added to accelerate the bonding process. If it no longer has any use, the Flexdym™ may also be un-bond from its substrate. This recyclable characteristic of Flexdym™ also renders it eco-friendly and low cost. Used Flexdym™ may be sterilized and re-molded to create new microfluidics chips with different designs.

INTRODUCTION

Easy bonding using Flexdym™ is possible thanks to its mechanical and surface properties which have been characterized. The Young modulus of Flexdym™ is 1.15 MPa, encouraging intimate contact with the surface of the substrate it is bond to.

HARDNESS SHORE A	35
SPECIFIC GRAVITY	0.9g/ cm^3
TEAR STRENGTH	15KN/ m
TENSILE STRENGTH	7.6 MPa
YOUNG MODULUS	1.15 Mpa
ELONGATION	720%
MELT FLOW RATE	2g/ 10min

Flexdym™ is a moderately hydrophobic material with dynamic contact angles (CA) measured at:

ADVANCING CA	105° ± 4°
RECEDING CA	88° ± 4°

Following oxygen plasma treatment, the static contact angles of Flexdym™ demonstrate stability for up to 4 days (time period limited by experiment length). This shows Flexdym™ has higher hydrophilic stability than PDMS.

Flexdym™ can bond to most substrates at room temperature thanks to its adhesive properties. The bonding strength of Flexdym™ depends on 3 key parameters: time, temperature and surface contact.

Flexdym™ can be strongly bond to itself, and a range of other polymers, including polystyrene (PS) and cyclic olefin copolymer (COC), withstanding fluidic pressures up to 2 Bar. Additionally, it can also be bond to glass substrate with moderate bonding strength.

Interestingly, Flexdym™ may be weakly bond to skin, potentially serving a unique function as a microfluidic skin patch.

For users interested in recycling their Flexdym™ devices, it is important to know that Flexdym™ binds to itself permanently.

Flexdym™ bonding to other polymers is reversible, however it becomes increasingly difficult as the time of contact increases. Reversible bonding is facilitated the most by glass substrates.

However, it is important to note this bonding behavior may vary depending on the material grade. If required, the bonding strength can be enhanced by using a coating agent on the substrate.

The Flexdym™ has 2-years shelf life warranty.

OVERVIEW OF FLEXDYM™ BONDING & ASSEMBLY

The bonding of Flexdym™ is a straightforward procedure, requiring one step: gently stack the Flexdym™ sheet on the substrate material by manual or automated lamination.

⚠ For glass substrates, bonding strength may be enhanced via oxygen plasma.

A key advantage of Flexdym™ is its ability to bind substrates at room temperature. This is ideal for biological applications, where damage of reagents or surface modifications must be avoided. Bear in mind, in this case the time required to bond Flexdym™ must be increased.

Bonding can be further optimized by applying heat and pressure to the device. This improves the surface contact between Flexdym and the substrate.

The best method involves using our Sublym100 machine or another hot press. Accordingly, results show that applying a pressure of 0.7-0.9 bar at 70C for 3 minutes, achieves the best bonding.

Another option is to heat the device inside of an oven, with a weight added on top.

If you are using an oven, the table below shows bonding parameters required for Flexdym™ bonding to different substrates:

SUBSTRATE	TEMPERATURE (°C)	TIME (min.)	BONDING STRENGTH
FLEXDYM	80 - 85	30	EXCELLENT
THERMOPLASTICS PS & COC	95	60	EXCELLENT
THERMOPLASTICS PC & PMMA	95	60	MODERATE
GLASS	95	60 - 120	MODERATE

REFERENCE

Lachaux, J., et al. (2017) Thermoplastic elastomer with advanced hydrophilization and bonding performances for rapid (30 s) and easy molding of microfluidic devices. Lab on a Chip 17, 2581-2594.

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Eden Materials is a division of Eden Tech
Registered Address: 83 Avenue Philippe Auguste, 75011 Paris, France | Client Facing Address: 4 Rue de Rambervillers, 75012, Paris, France
T: + (33) 188 327 405 E: contact@eden-microfluidics.com W: www.eden-microfluidics.com