Exploring the Limits of Vacuum Casting Technique for Micron and SubMicron Features

ABSTRACT: A study of resolution limits in standard rapid prototyping vacuum cast molding processes and adaptation of this technique to reach submicron accuracy is proposed. Microfabrication technologies are used to fabricate micron and submicron high aspect ratio patterns on the original parts. The molding of the original parts is optimized to allow replication of submicron features. In carefully exploring materials and surface treatments, cast parts are successfully replicated with as-micron and high aspect ratio micron structures. These encouraging results enable the use of such processes for micro- and nano-systems applications and open the door to development and production of low cost, high resolution biosensors.

CONCLUSION: The adaptation to the replication of microstructures of a conventional rapid prototyping technique was investigated. According to the experimental results, a conventional vacuum casting process with minor improvements can be applied to the fabrication of microstructures. High quality materials are essential to overcome dewetting and adhesion problems, but the most important factor to achieve submicron (down to 300nm) and high aspect ratio (up to 1:10) performances. The improved vacuum casting process allows accurate replication of microstructures made with standard microtechnologies. A small study has been performed for specific bio-chip microsystem application. The results of this study, illustrated in the graphics below, stress the cost-effective domain of the technique - from a few parts to a few thousands parts. Therefore, improved vacuum casting meets the need for small series of micro-structured structures made of polymers. Because of its high speed to first part and low-cost, the adaptation of the vacuum casting process to microfabrication will lead to a promising technology for MEMS application. This is indeed a valuable technique for rapid prototyping of micro-systems. The use of improved vacuum casting techniques can be applied to different micro-injection molding techniques that require significant time and money investments.

- Vacuum casting validated for submicron and high aspect ratio structures replication,
- Rapid prototyping of polymer microsystems applications,
- Cost-effective for small volumes.