Scaling the Nanoimprint Lithography Process of Inorganic-Based Materials

Mehrnaz Modaresialam[1], Antony Gourdin[1], Badre Kerzabi[1], David Grosso[1,2], Martin O'Byrne[3], Mohammed Bouabdellaoui[1], and **Marco Abbarchi**[1,3]

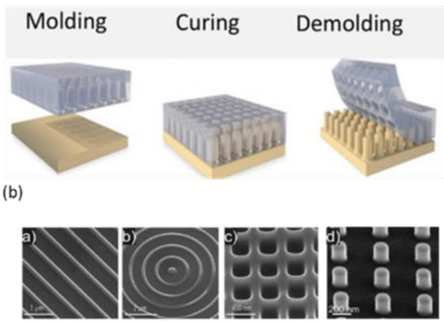
[1]Solnil, 95 Rue de la Republique, Marseille 13002, France

[2]Aix-Marseille Univ, CNRS, CINaM, 13009 Marseille, France

[3]Aix-Marseille Univ, CNRS, IM2NP UMR 7334, 13397 Marseille, France

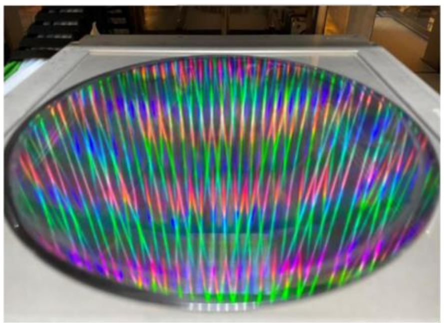
Nanoimprint lithography (NIL) is a method to (nano-) structure inorganic materials from sol-gel liquid formulations and colloidal suspensions onto a surface [1]. This technique, first inspired by embossing techniques, was developed for soft polymer processing, as final or intermediate materials, but is today fully adapted to hard, inorganic materials with a high dielectric constant, such as metal oxides, with countless chemical compositions provided by the sol-gel chemistry. Consequently, NIL has become a versatile, high-throughput, and highly precise fabrication method that is mature for scaling up. In my presentation I will first describe generalities of sol-gel dip-coating and NIL method for metal oxides (e.g. SiO_2, TiO_2, ZrO_2) showing the possibility to form high refractive index materials (n up to 2.65 for dense TiO_2). Then, I will review some of the recent results we obtained in this field, including fabrication of ordered and disordered optical metasurfaces [2], structural color [3], anti-reflection coatings [4] on flat and curved surfaces, refractive index sensing [5], light emission and enhanced light extraction [6]. Finally, I will show that the method can be scaled up to 200 mm wafers on Si and glass to print ordered and disordered patterns.

Top: basic principle of NIL. Bottom: examples of metal-oxides structures obtained via NIL



Gratings of SiO_2 printed atop curved surfaces (lenses)

Example of SiO_2 pillars printed on a 200 mm Si wafer with a semi-industrial Obducat machine.



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