Self-assembly of lines of microscopic photonic crystals

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Abstract. Lines of identical photonic crystals (PhCs) were obtained by the method of intermittent motion of the meniscus during evaporation of a colloidal solution. Periodically repeating ridges consisting of close-packed SiO_2 microspheres were formed parallel to the contact line. The thickness of each deposited ridge was sufficient to show the properties of a PhC. The period of the structures was about 140-300 μm. Both the period and the thickness of the ridges depend on the solution concentration and evaporation temperature.

1. Introduction

Driven by the concept of lab on a chip, we develop lines of microscopic PhCs by a self-assembly approach. Our method is more simple and non-destructive compared to cutting methods with the help of machine tools. The obtained lines of PhCs can probably be used, for example, as microscopic chemical sensors.

2. Experimental

SiO_2 colloidal microspheres of 200-300 nm in diameter were synthesized by the method presented in [1]. The method of fabrication of lines of identical PhCs was based on intermittent, ‘‘stick–slip’’ motion of the meniscus during evaporation of a colloidal solution [2]. We used sufficiently concentrated ethanol-based suspensions of SiO_2 microspheres (up to 1 g/l) and low temperatures of evaporation (31-34 °C). The fabricated structures were investigated by optical microscopy, scanning electron microscopy, light interference microscopy and local optical spectroscopy.

3. Results

The structures consisting of parallel ridges of deposited SiO_2 microspheres repeating with a period of 140–300 μm and empty gaps between them have been prepared. Some examples corresponding to different suspension concentrations are shown in Figures 1 (a, b). Each ridge consists of particles that form a close-packed array, as shown in Fig. 1(c). Both the period and the thickness of the ridges depend on the solution concentration and evaporation temperature [2]. In the thickness of the ridges shown in Fig. 1 (a), there are more than 6 layers of close-packed microspheres, so such ridges can show the properties of PhCs. In order to test them we carried out local transmission measurements for one of the ridges (Fig. 1(d)). The drop in the transmittance spectrum related with the photonic band gap is clearly seen at 516 nm.

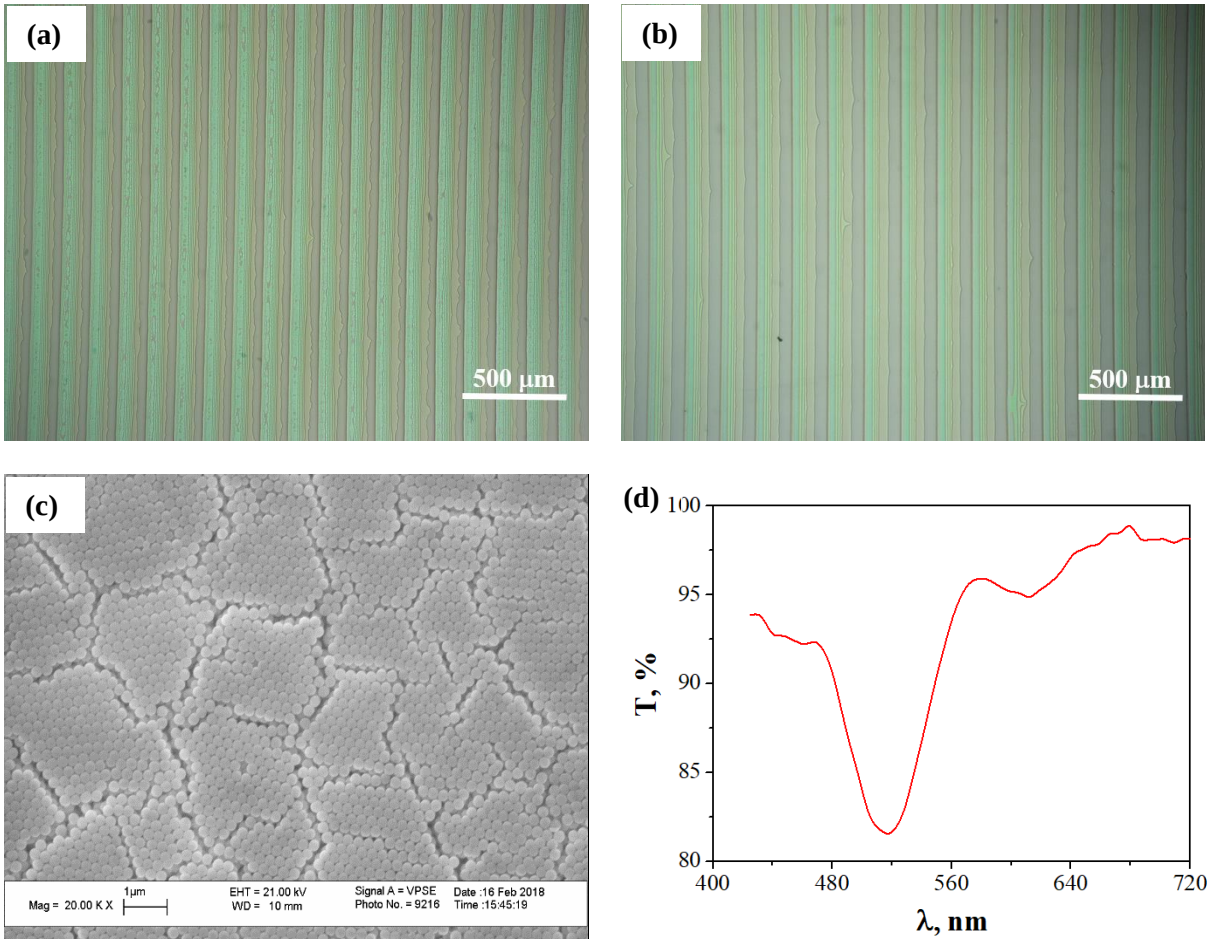

Figure 1. **(a)** and **(b)** – microphotographs of lines of PhCs prepared using suspensions with different SiO_2 concentrations at different evaporation temperatures: 0.83 g/l, 31 °C and 0.41 g/l, 34 °C, correspondingly; **(c)** – SEM image of the top of a ridge; **(d)** – a local transmittance spectrum for one of the ridges shown in (a).

4. Acknowledgments

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5. References

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