Monocrystalline silicon microsphere fabricated by optical vortex laser illumination

Chiba Univ.[1], Hokkaido Univ.[2], Alimiti Abulizi[1], Honami Fujiwara[1], Kai Izumisawa[1]
Katsuhiko Miyamoto[1], Ryuji Morita[2], Takashige. Omatsu[1]
E-mail: omatsu@faculty.chiba-u.jp

Semi −conductive microspheres, e.g., silicon microspheres, play an important role in photonics as whispering gallery mode micro-lasers [1]. Several methods to fabricate microspheres, such as chemical vapor decomposition and laser ablation, have been demonstrated, so far. The aforementioned methods enable the fabrication of the porous, polycrystalline microspheres, however, they are difficult to produce monocrystalline microspheres.

Optical vortex, carrying an annular intensity profile and orbital angular momentum associated with helical wave front, has been widely investigated in a variety of fields, such as optical manipulations and super-resolution microscopes. To date, we and co-workers discovered that a single picosecond optical vortex pulse twists the silicon to establish a monocrystalline silicon needle together with monocrystalline micro-sized silicon spheres by orbital angular momentum transfer effects [2]. The fabricated silicon microspheres with relatively high spherecity exhibited a diameter of ~3μm with a standard error of 0.6.

In this presentation, we report on physical properties of the monocrystalline silicon microspheres fabricated by optical vortex illumination.

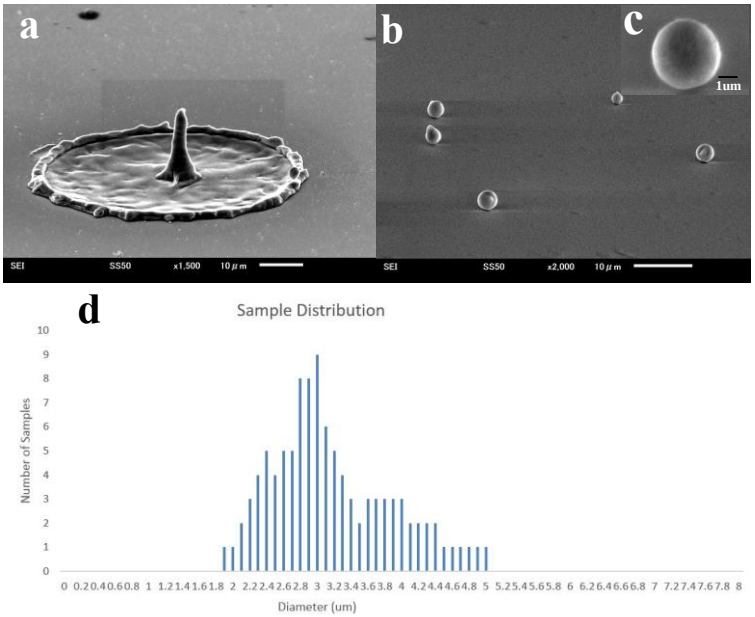

Figure (a) Monocrystalline silicon needle; (b) Silicon spheres; (c) Enlarged view of a Si sphere; (d) Histogram of the fabricated silicon Sphere's diameter.

References

[1] Shan chengYang, Van Duong Ta, Yue Wang, Rui Chen , Tingchao He, Hilmi Volkan Demir1, & Handong Sun. Reconfigurable Liquid Whispering Gallery Mode Micro lasers. Scientific Reports 6, 27200 1-9 (2016).

[2] F. Takahashi, K. Miyamoto, H. Hidai, K. Yamane, R. Morita, T. Omatsu. Picosecond optical vortex pulse illumination forms a monocrystalline silicon needle. Scientific Reports 6, 21738 1-9 (2016).