

Rapid Preparation of Ultra-thin Black Silicon for Infrared Stealth Through Single-side Thinned Method

Ye Jiang*, Ying Chen#, Xue Feng†

* Institute of Flexible Electronic Technology of THU, Zhejiang, Jiaxing, 314000, China
 (jiangye@ifet-tsinghua.org)

AML, Department of Engineering Mechanics, Tsinghua University, Beijing, 100084, China
 (chenying@ifet-tsinghua.org)

† AML, Department of Engineering Mechanics, Tsinghua University, Beijing, 100084, China
 Center for Flexible Electronics Technology, Tsinghua University, Beijing, 100084, China
 (fengxue@tsinghua.edu.cn)

Abstract

The flexible electronic devices based on inorganic semiconductor materials have broad application prospects. The efficient preparation of ultra-thin crystalline silicon is a great challenge. To effectively hide objects and render them invisible to thermographic detectors, their thermal signatures in the infrared (IR) region of the spectrum may be concealed.

In this work, silicon with single-side PDMS protection for silicon thinning and texturing was researched. Metal assisted chemical etching (MACE) method was used to realize single-side thinning of monocrystalline silicon wafer (3 μ m) and fabrication of surface nanostructure. The results show that the nano-structure can almost completely hide the thermal emission of the object with its unique properties. The infrared emission in the range of 3-5 μ m is lower than 0.2, and keeps a low level with the increase of temperature.

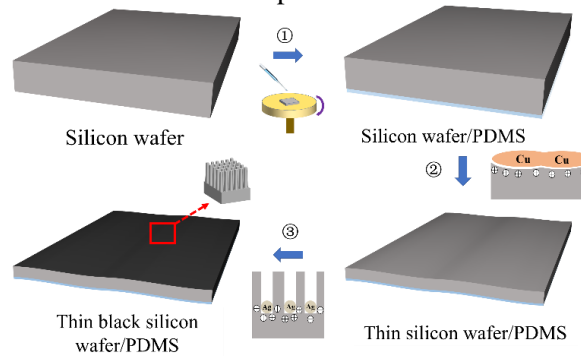


Figure 1. Schematic illustration of the etching process of ultra-thin black silicon: ① Spin coating PDMS; ② Cu MACE; ③Ag MACE.

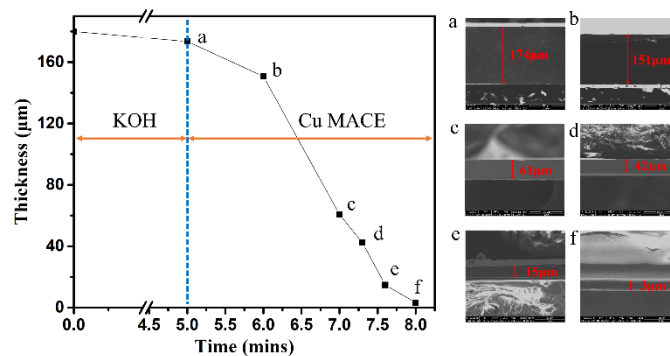


Figure 2. Dependence of the thickness of the etching time and cross-sectional SEM images of thin silicon with different thickness (a-f).

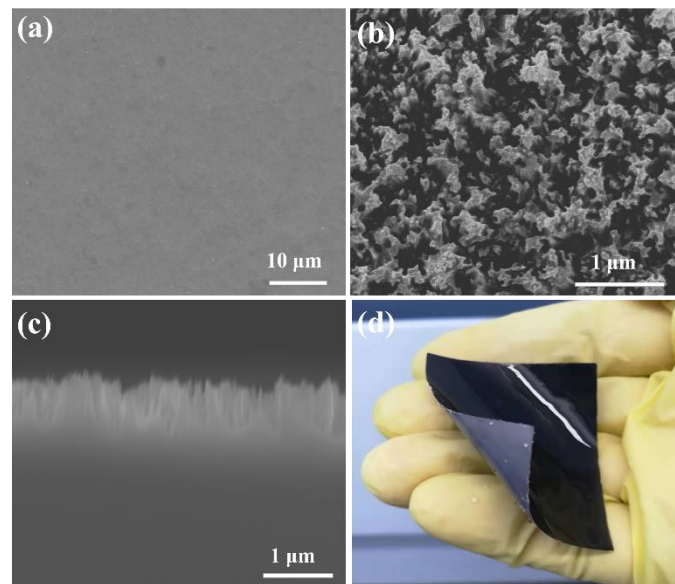


Figure 3. Top-viewed SEM images for thin silicon surface after (a) Cu MACE process and (b) Ag MACE process, (c) cross-sectional SEM images of thin silicon after Ag MACE process, (d) optical image of 15- μ m-thick Si textured with nanowires, side length of silicon wafer is 40mm.