Interdigitated back contact (IBC) silicon solar cells where the junction and the contacts are placed at the back surface have achieved high power conversion efficiency (PCE) up to 24% by avoiding light shading losses and Auger recombination losses at the front surface [1]. However, the conventional IBC solar cells are not cost-effective model due to a complexity of fabrication processes including thermal doping (≥ 900 °C) and complicated photolithography processes. In detail, the emitter and back surface field (BSF) regions are formed by high temperature doping using patterned diffusion masks. Furthermore, the two different doped region requires strict separation with additional align process. Recently, a dopant-free, heterojunction back contact (HBC) solar cell has been paid much attention as an alternative low-cost fabrication strategy. In particular, transition metal oxides such as molybdenum oxide (MoO$_3$), tungsten oxide (WO$_3$), vanadium oxide (V$_2$O$_5$) have been introduced to HBC solar cells as selective hole contact while electron contact have been developed by alkaline metal compounds such as lithium fluoride (LiF) because of their simple and direct deposition processes at room temperature.

To reduce the fabrication cost further, we developed a thin crystalline Si substrate via an exfoliation process. One of the main costs of solar cell is a Si wafer which account for more than 40% of total process cost. Therefore, the total amount of Si used per solar cell has to be decreased by reducing the thickness of the Si. The exfoliation induced by high stress from the electrodeposited Ni layer on the Si can be a suitable process to reduce the thickness of the crystalline Si by detaching thin Si film from conventional Si wafers without kerf-loss. The thickness of the exfoliated thin Si film is around 50 μm, which is the minimum required for sufficient photon absorption. An exfoliated thin film and the mother wafer are shown in Fig. 1. Herein, we have described the HBC solar cells using exfoliated thin Si film. The effective lifetime of exfoliated Si substrate was measured. With an additional treatment process after exfoliation, we found that the result reveals no critical degradation of the effective lifetime on exfoliated surface after treatment compared to a polished wafer, indicating that exfoliated layers have similarly high quality compared with mother Si wafer and they are enough to fabricate into solar cells. Also, the properties of HBC solar cells were investigated using J-V curves and external quantum efficiency (EQE) measurements.

**Figure 1** Exfoliated thin Si film (right) from the mother wafer (left)

References