Supplementary Information

Peel-and-Stick: Mechanism Study for Efficient Fabrication of Flexible/Transparent Thin-film Electronics

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Figures S1-S3:

Figure S1. Basic procedures of the peel-and-stick process. (Step 1) Thin-film electronic devices are fabricated on a metal (*e.g.*, Ni, Cu) coated SiO_2/Si wafer. A removable protection layer (*e.g.*, Polymethyl methacrylate (PMMA)) can be applied on top of the thin-film electronic devices to protect them from water. **(Step 2)** Entire structure is soaked in a water bath at 21°C, and with a temporary holder (*e.g.*, thermal release tape), an edge of the structure is slightly peeled back to promote the water-assisted subcritical debonding at the metal-SiO_2 interface. **(Step 3)** The peeled thin-film electronic devices are pasted on a receiver substrate using a commercial adhesive agent (*e.g.*, Polydimethylsiloxane (PDMS), Polyvinyl alcohol (PVA)). After the peel-and-stick process, the SiO_2/Si wafer can be reused.

Figure S2. Experimental setup for double-cantilever-beam tests. (a) An optical image and schematic of the experimental setup for the double-cantilever-beam tests used to measure the debond growth rate of the Ni-SiO_2 interface in a water bath at 21°C. **(b)** A schematic of the structures and thicknesses used for the double-cantilever-beam specimen.

Figure S3. Surface characterizations of the delaminated Ni film and spin-on-glass surfaces. (a) An optical image of the delaminated Ni film (left) and spin-on-glass (right) surfaces. **(b)** Corresponding 3D optical images of the delaminated Ni film (top) and spin-on-glass (bottom) surfaces. Defects are shown on both surfaces due to the inherent strong adhesion of the spin-on-glass.

Movies S1-S3:

Movie S1. Molecular Dynamics (MD) simulation for the peel-off process of Ni-SiO_2 interface in dry-air environment.

Movie S2. Molecular Dynamics (MD) simulation for the peel-off process of Ni-SiO_2 interface in low-moist environment.

Movie S3. Molecular Dynamics (MD) simulation for the peel-off process of Ni-SiO_2 interface in high-moist environment.

Figure S1.

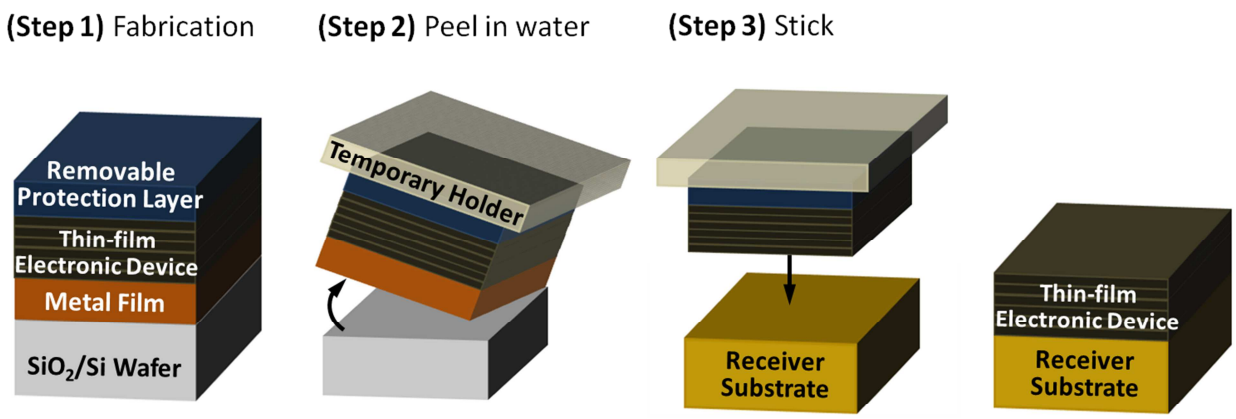

(Step 1) Fabrication
(Step 2) Peel in water
(Step 3) Stick
Removable Protection Layer
Thin-film Electronic Device
Metal Film
SiO2/Si Wafer
Temporary Holder
Receiver Substrate
Thin-film Electronic Device
Receiver Substrate

Figure S2.

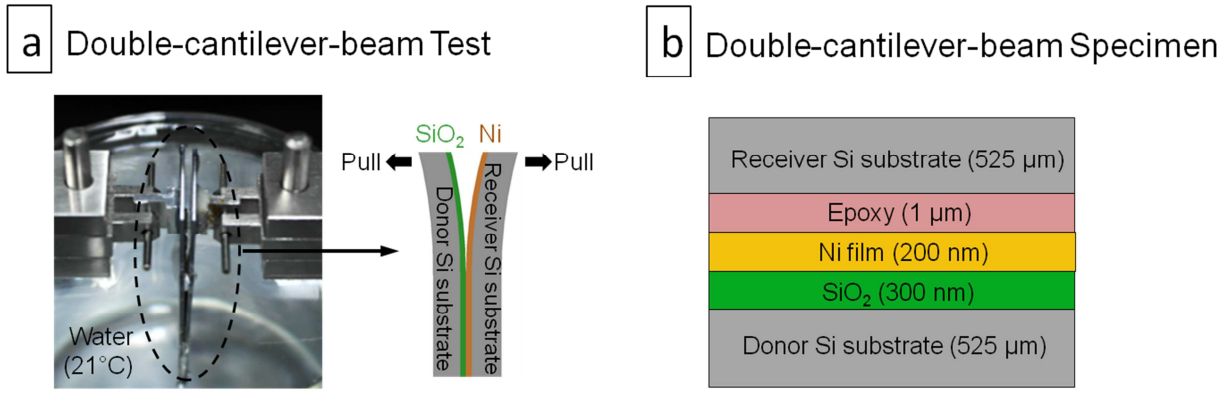
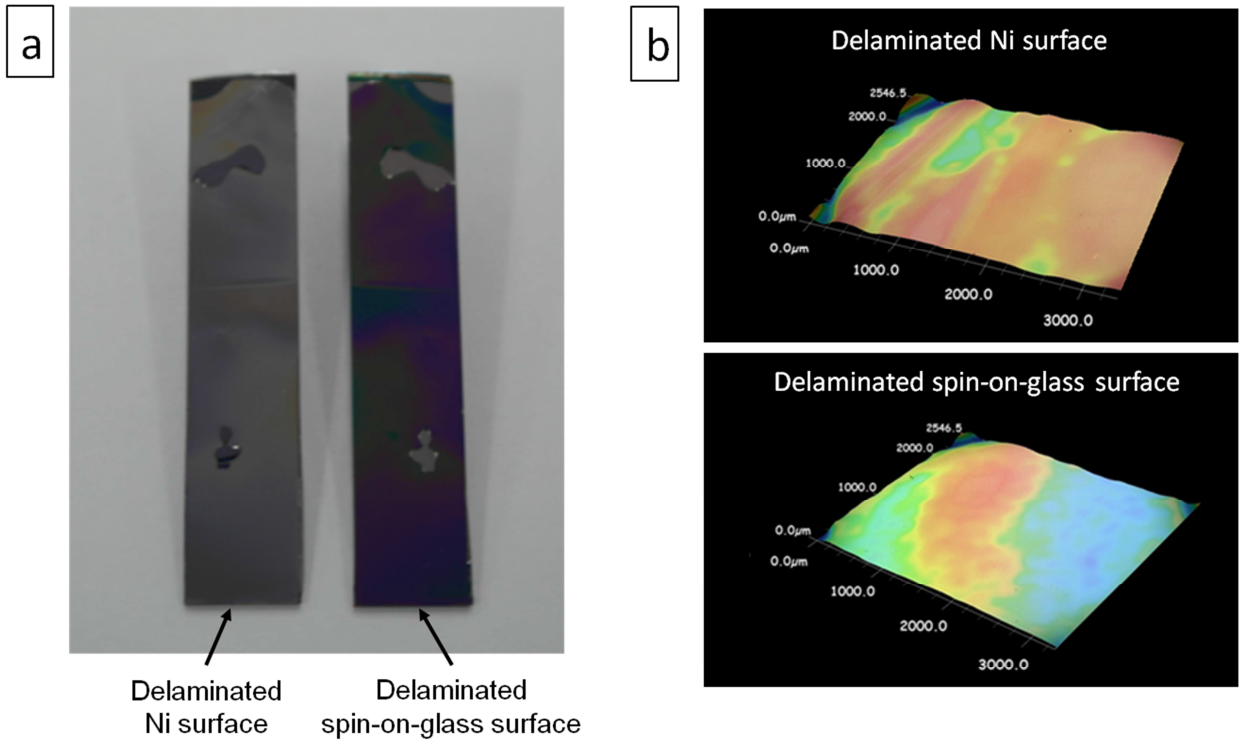
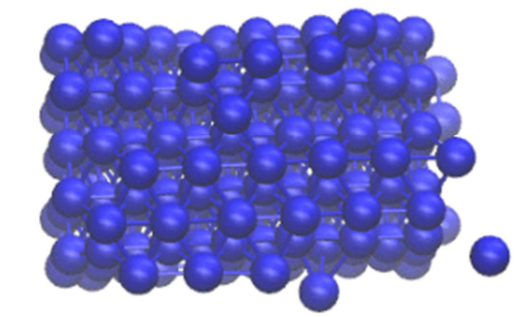
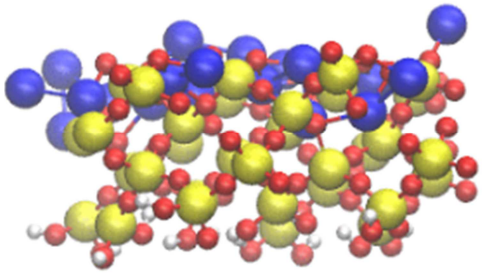

a
Double-cantilever-beam Test
Water
(21°C)
Pull
Pull
SiO2
Ni
Donor Si substrate
Receiver Si substrate
b
Double-cantilever-beam Specimen
Receiver Si substrate (525 μm)
Epoxy (1 μm)
Ni film (200 nm)
SiO2 (300 nm)
Donor Si substrate (525 μm)

Figure S3.

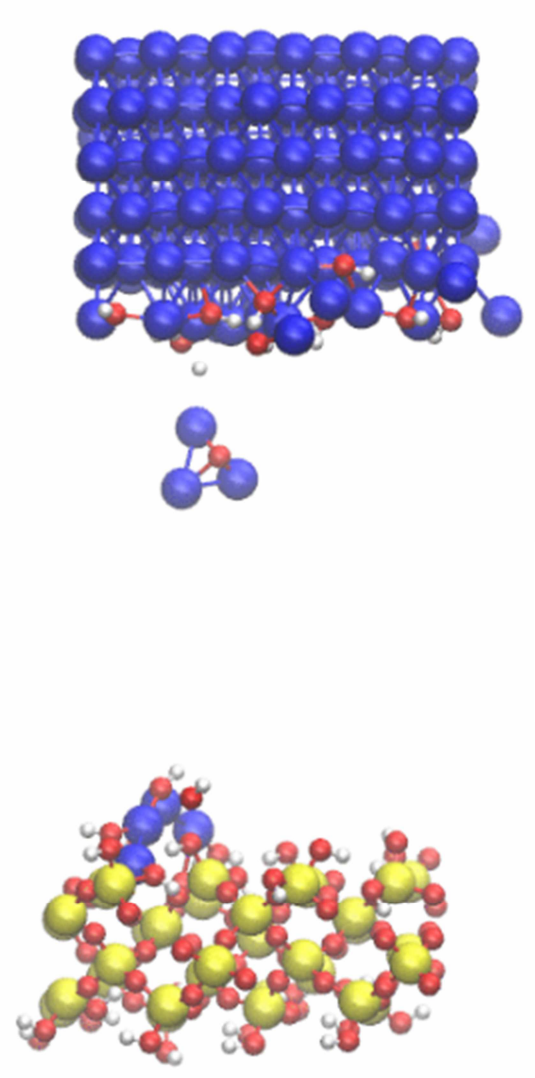

a
Delaminated
Ni surface
Delaminated
spin-on-glass surface
b
Delaminated Ni surface
2546.5
2000.0
1000.0
0.0μm
0.0μm
1000.0
2000.0
3000.0
Delaminated spin-on-glass surface
2546.5
2000.0
1000.0
0.0μm
0.0μm
1000.0
2000.0
3000.0

Movie S1 Still Image.





Movie S2 Still Image.



Movie S3 Still Image.