הטכניון - מכון טכנולוגי לישראל

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע״ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Special Seminar

Lecture Hall 6, Wolfson Department of Chemical Engineering,

6th October, 2016 at 11:30

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Low-Temperature Direct Bonding of Silicon Nitride to Glass with no Adhesion Layer

Recent years have shown an increasing interest in the study of direct bonding of surfaces, mostly due to its prospects in the areas of integrated circuits and micro-electro mechanical systems. These applications include SOI (silicon on insulator) wafers, SOG (silicon on glass), SOS (silicon on sapphire) and encapsulation of MEMS devices (3D-integration). In a direct bonding process, two mirror-polished flat, smooth and surface-activated substrates adhere to each other at room temperature without any adhesives and upon applying minimal external forces.

Direct bonding may provide cheap and reliable alternatives for the use of adhesives in the photovoltaic cells (PV) industry. Silicon-based solar cells contain several layers and the adhesion between them is an important factor, which affects the fabrication and the performance of the cells. Silicon nitride is extensively used as an anti-reflective coating in the PV industry and glass is used to externally cover the device.

The direct bonding of silicon nitride and glass surfaces, with no adhesive layer, is reported here for the first time. The various morphological and chemical properties of the two surfaces and of the resulting interface were studied by XPS, ATR-FTIR, HRTEM-EELS, EDX and other methods. HRTEM-EELS analysis revealed a defect-free interface of about 4 nm, containing Si, O and N atoms, along which sharp concentration changes were observed. The XPS spectra of the glass and the silicon nitride surfaces showed a clear response to activation under both oxygen and nitrogen plasma. The bonded pair which was activated by oxygen for 80 s and thermally annealed at 300 °C for 1 h resulted in the highest bonding energy and the lowest void quantity and void area. Possible mechanisms for the bonding process are discussed.

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Refreshments served at 11:15