PATENTED TECHNOLOGIES AT OAKLAND UNIVERSITY—2013

1. **Sheet metal stretch-bend-draw simulator apparatus and method (Lorenzo Smith, Patent No. 8,511,172) August 20, 2013**

Lay summary: The objective of this simulator is to allow the experimental evaluation of forces associated with pulling off sheet metal strips over a rigid tool, and for further understanding the mechanisms triggering surface distortions in sheet metal products. The stretch-bend-draw bead simulator (SBDS) apparatus can be used to evaluate a proposed draw bead design/geometry before it is implemented in a continuous manufacturing process.

Technical summary: A stretch-bend-draw simulator (SBDS) apparatus for approximating die stamping of a metal is disclosed. The simulator includes a tool having a surface for contacting a sheet metal strip clamped in a jaw grip adapted to pull the sheet metal strip to provide a force measurement. A tool holding and moving device can be included for mounting, translating, and positioning the tool with respect to the sheet metal strip. The tool can be mounted on the tool holding device at a distal end or on a mounting plate of the apparatus. The tool holding device is coupled to a contact force measuring load cell for measuring the contact force. A draw bead block holder is provided that is adapted to mount a corresponding male and female draw bead blocks. The holder includes a compressing means for compressing the draw bead blocks together to clamp the strip. A clamping force measuring load cell is provided for measuring a clamping force resulting from the draw bead blocks clamping on the sheet metal strip. The simulator can include a base clamping device for mounting the sheet metal strip at an opposite end. The base clamping device is positioned adjacent the draw bead block holder and coupled to a back force measuring means for measuring a back force resulting from holding the sheet metal strip while the jaw grip pulls the sheet metal strip. The apparatus is adapted to analyze skid lines on the sheet metal strip resulting from contact with the tool.

2. **Method of Wafer-Level Fabrication of MEMS Devices (Hongwei Qu, Patent No. 8,445,324) May 21, 2013**

Lay summary: This invention relates to wafer-level microfabrication methods for micro-elecromechanical systems (MEMS) devices. The method can be applied to the fabrication of complementary metal oxide semi-conductor (CMOS) -MEMS sensors and actuators, where electrical isolation of MEMS structures and conditioning circuitry is needed. The method overcomes drawbacks of other microfabrication processes, including isolation trench sidewall contamination.

Technical summary: The present disclosure relates to a method of fabricating a micromachined CMOS-MEMS integrated device as well as the devices/apparatus resulting from the method. In the disclosed method, the anisotropic etching (e.g., DRIE) for isolation trench formation on a MEMS element is performed on the back side of a silicon wafer, thereby avoiding the trench sidewall contamination and the screen effect of the isolation beams in a plasma etching process. In an embodiment, a layered wafer including a substrate and a composite thin film thereon is subjected to at least one (optionally at least two) back side anisotropic etching step to form an isolation trench (and optionally a substrate membrane). The method overcomes

drawbacks of other microfabrication processes, including isolation trench sidewall contamination.

3. **Ionic Liquid Thin Layer Sensor for Electrochemical and/or Piezoelectric Measurements (Xiangqun Zeng, Patent No. 8,375,768) February 19, 2013**

Lay summary: This sensor can detect environmental gases, such as explosive vapors. The technology has the advantage of combining two different methods (electrochemical and piezoelectric) in a single sensor, which can be used in quantitative and qualitative detection systems.

Technical summary: An electrochemical piezoelectric sensor is disclosed. The sensor includes a piezoelectric substrate, three (or more) electrodes over a first surface of the substrate, and another electrode over a second (opposing) surface of the substrate. An ionic liquid in the form of a film is adhered, bound, immobilized, or otherwise positioned over the substrate and electrodes of the first surface. The ionic liquid film permits the absorption and detection of analytes from a gaseous sample, for environmental gases, example explosive vapors and/or explosive vapor species in the gaseous sample. Detection (optionally including analyte quantitation and qualitative identification) can be performed by both electrochemical and piezoelectric techniques using a single sensor. Systems incorporating and methods of using the electrochemical piezoelectric sensor also are disclosed.