

# Flexible Biocompatible Integration Platform for Biomedical Sensing

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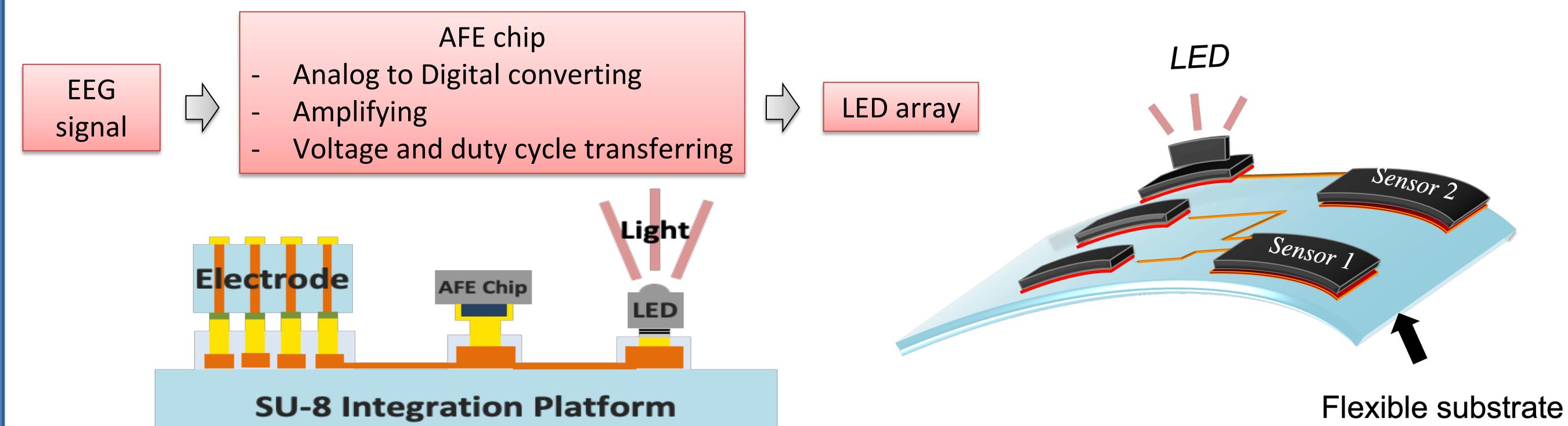
## Introduction

### Background

- Techniques in advanced packaging are mainly based on the rigid silicon-based substrates, challenging the applications in biomedical science.
- In response to the current trend of biomedical electronics, it is hoped to achieve real-time monitoring of human physiological changes.

### Accomplishments

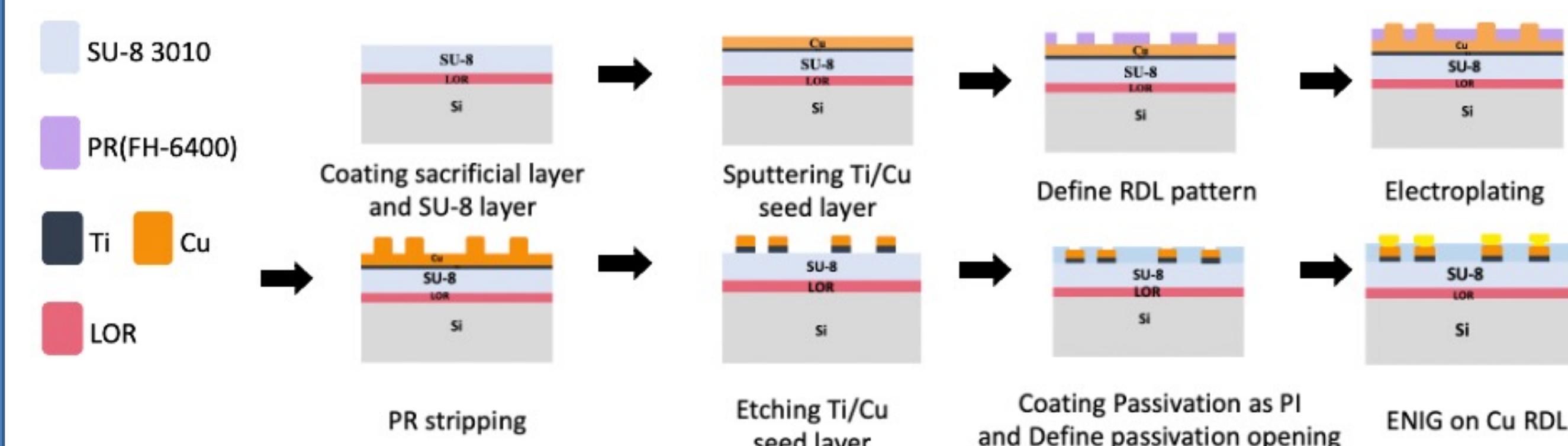
- Development of an ultra-thin flexible substrate.
- Demonstration of a biocompatible heterogeneous integration platform.
- Direct bonding method is adopted to replace wire bonding.
- Concept of optical transmission is proposed.



## Process Flow

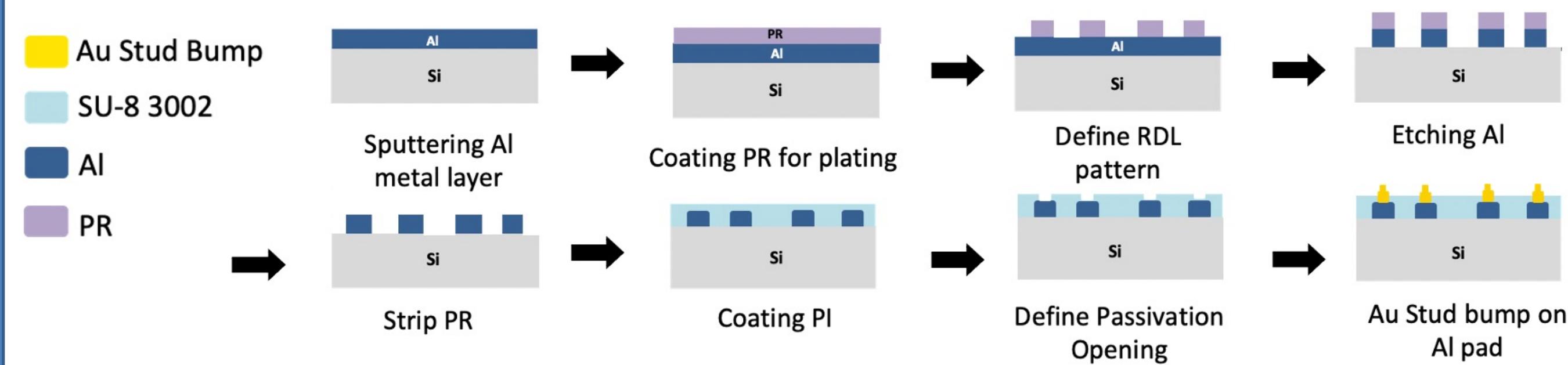
### Process Flow of the Bottom Die

- 10  $\mu\text{m}$  SU-8 is deposited as a biocompatible substrate on LOR sacrificial layer by spin coating.
- Biocompatible passivation is coated to keep copper from exposing.
- All the materials on the surface are made sure to be biocompatible



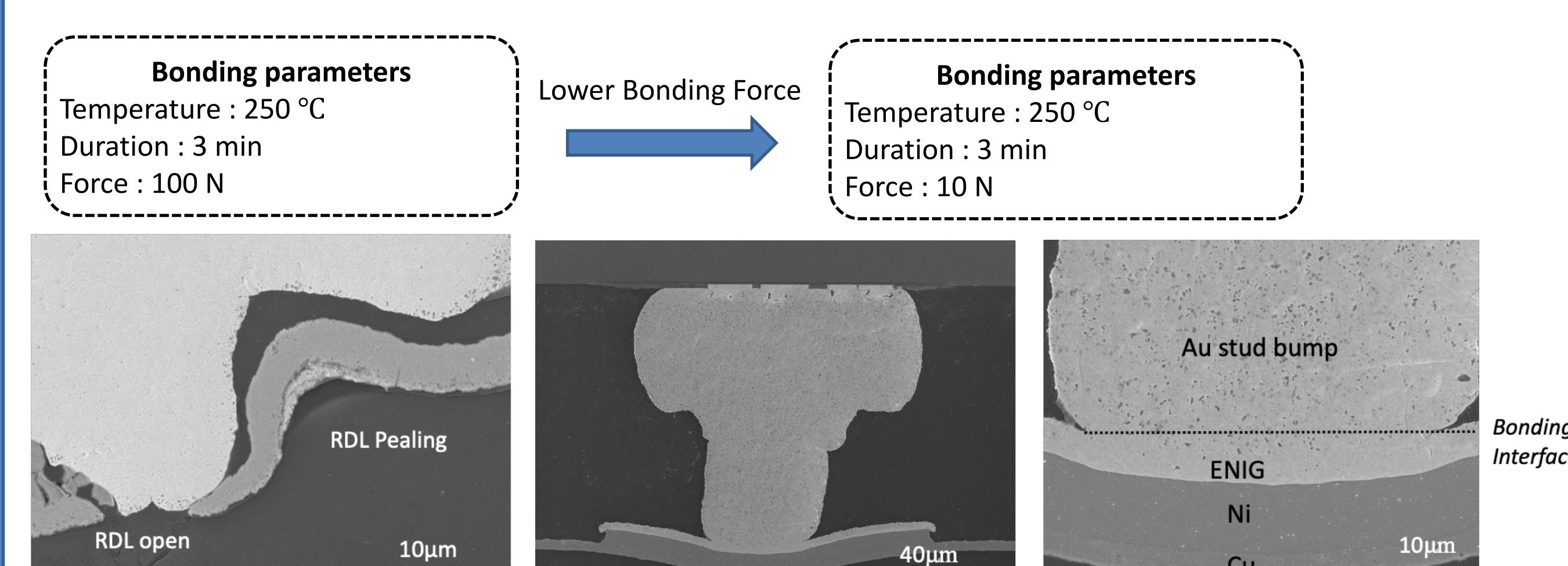
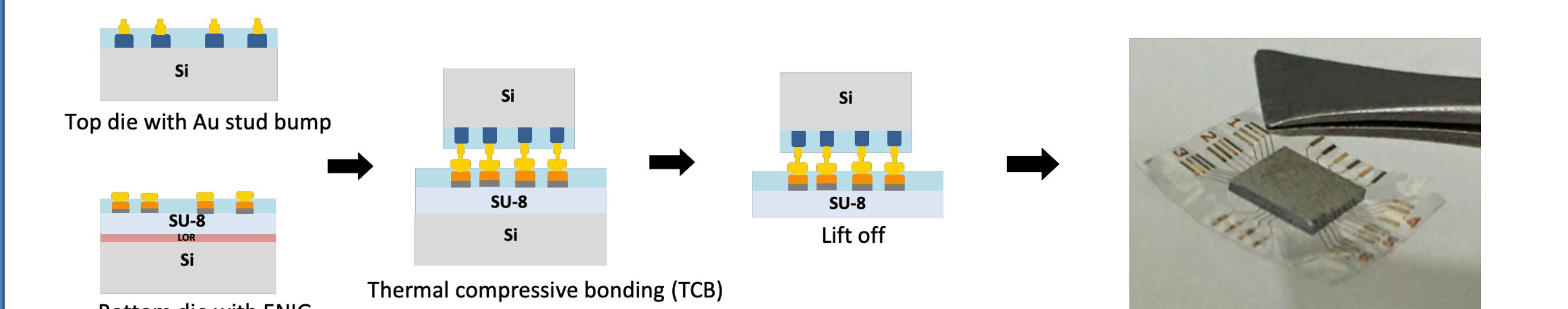
### Process Flow of the Top Die

- Au stud bump is fabricated on Al pad to simulate real functional chip.



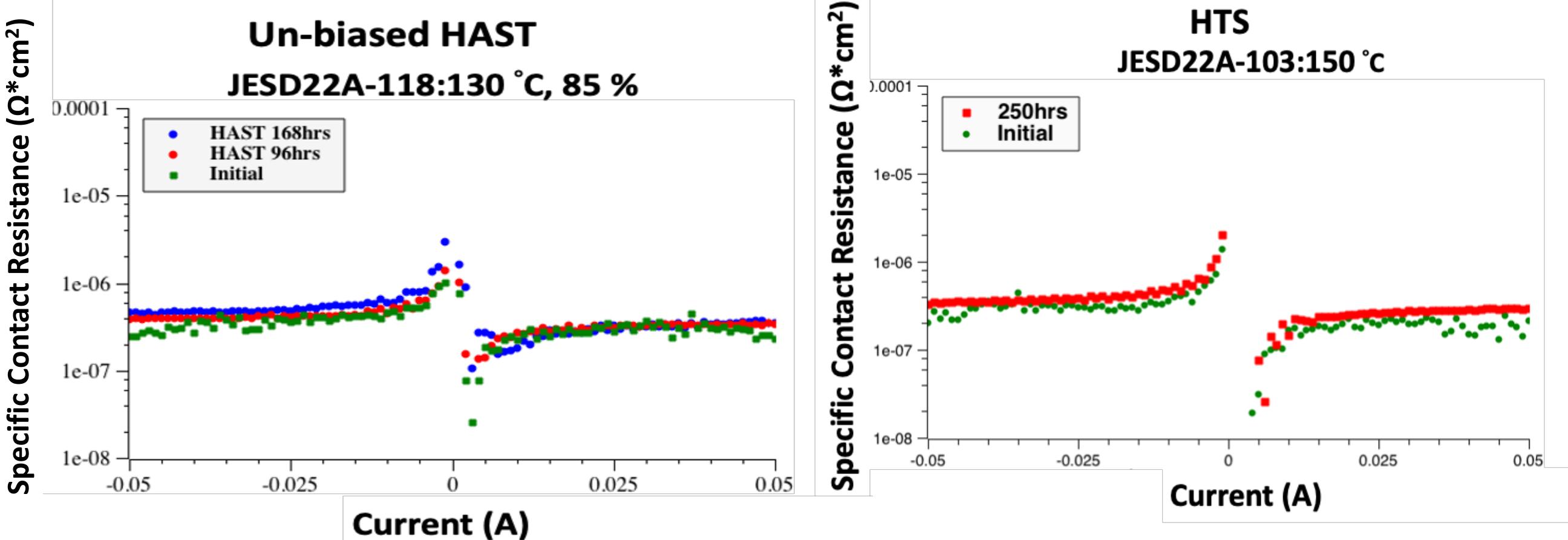
### ENIG to Au Stud Bump Bonding

- Flexible substrate with TCB technology is presented.
- High bonding force on flexible substrates may cause deformation in RDL.



### Electrical Measurements

- Samples pass un-biased HAST and HTS.
- The specific contact resistance maintains at 10-7  $\Omega \cdot \text{cm}^2$ .

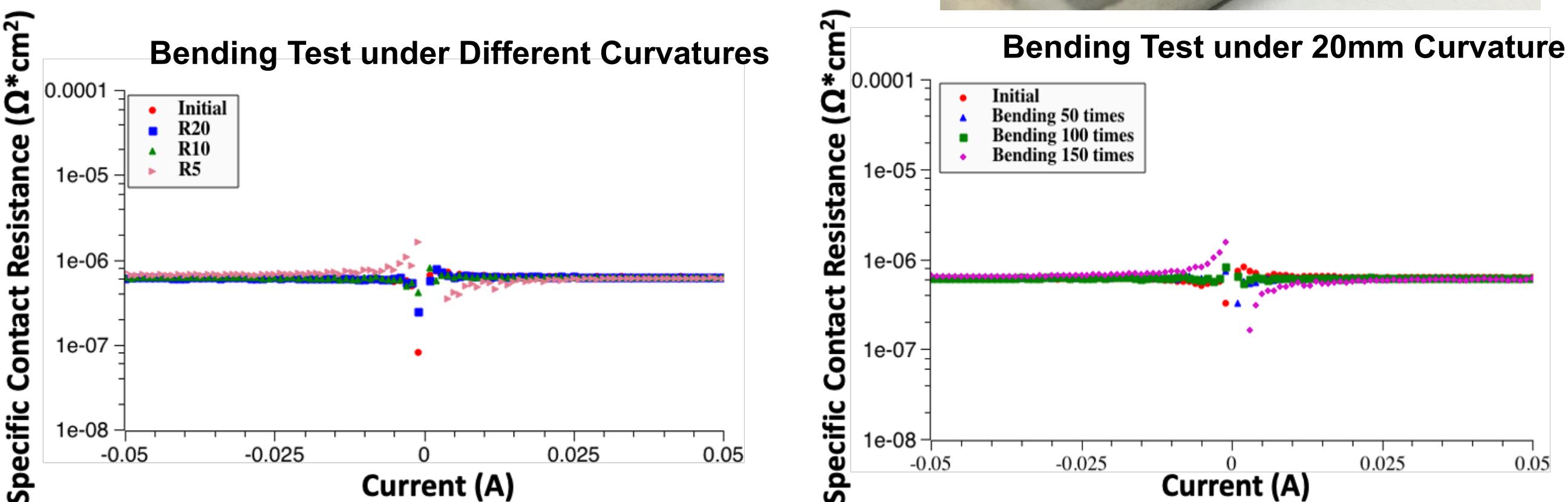
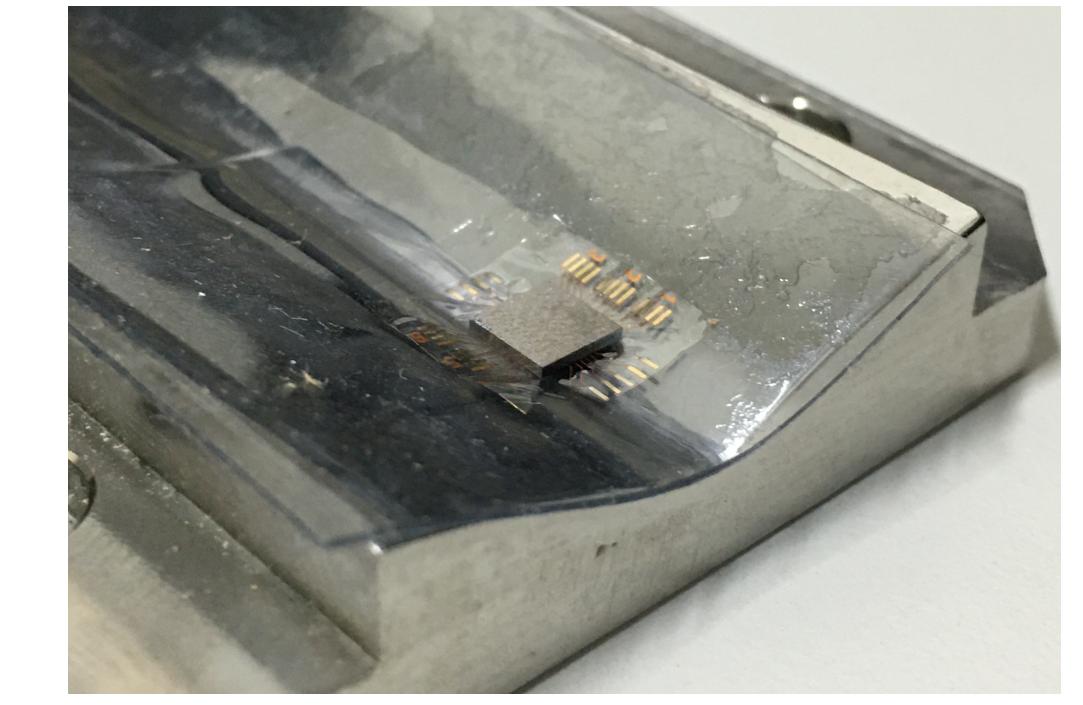


### Bending Test

- The electrical properties can maintain with variations less than 5%.

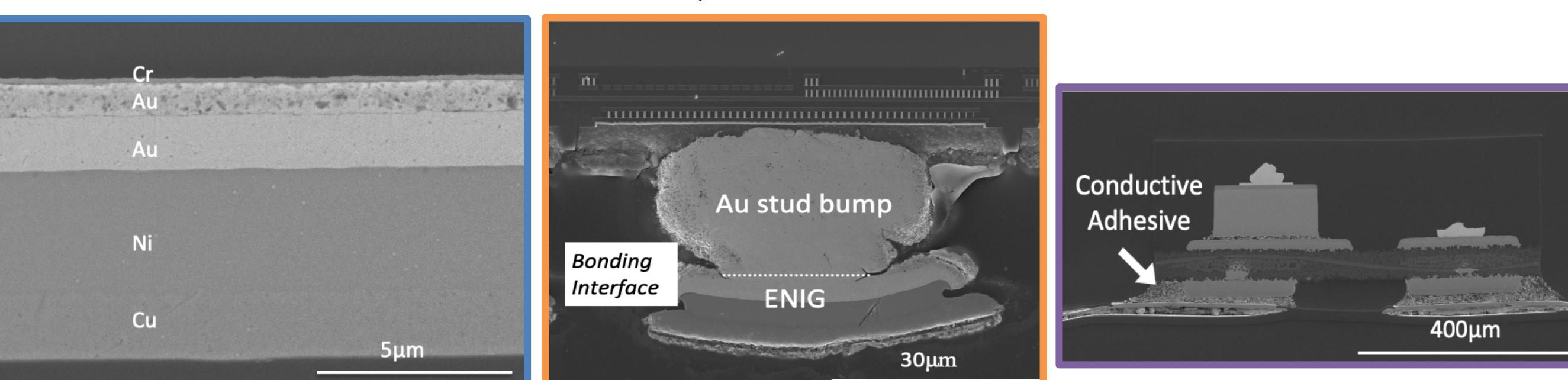
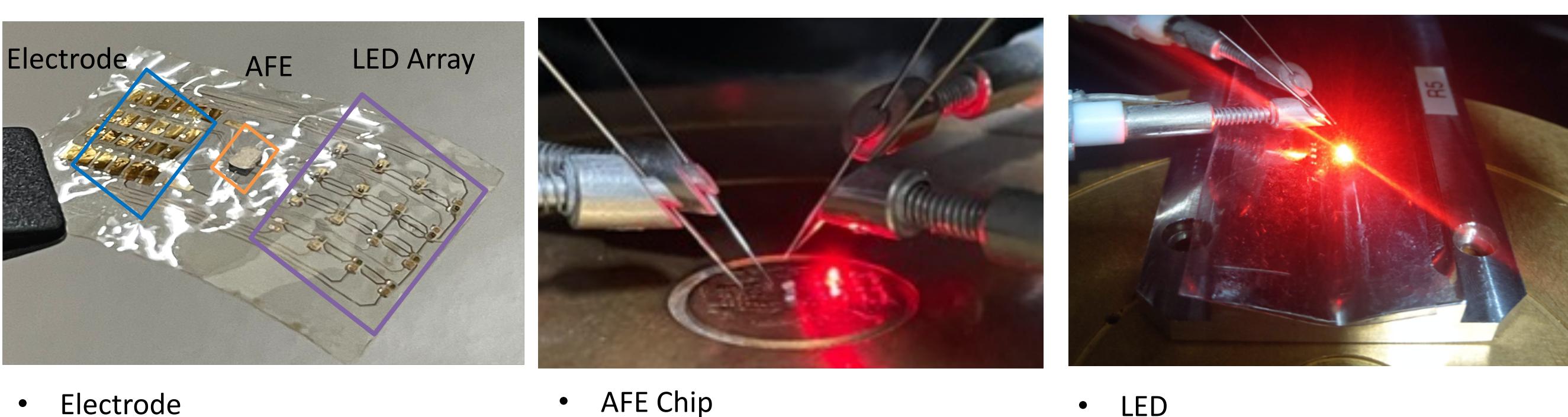
**Bending parameters**

- Curvature: 20 mm/ 10 mm/ 5 mm
- Bending test is repeated 150 times on R20 tool



## Implementations of Functional Devices

- AFE chip with the structure same as the top die was integrated to the platform using TCB with parameters (250°C, 3min, 10N).
- Conductive adhesive is adopted to integrate LED arrays on the platform.



## Conclusions

### Development of Flexible Biocompatible Heterogeneous Platform

- SU-8 is selected to fabricate the ultra thin biocompatible substrate.
- Appropriate bonding parameters for TCB on flexible substrate are proposed.
- Reliability tests and bending tests are carried out to verify the stability of this flexible biocompatible substrate.

### Application on Heterogenous Integration Platform

- Electrode, Functional AFE chip and LED are integrated on the flexible substrate with suitable integration approach.
- Bending test for more than 200 times indicates the excellent stability of this bonding scheme.

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