

# Thermal behavior of metal multilayer film investigated by *in-situ* heating TEM and STEM-EDX techniques

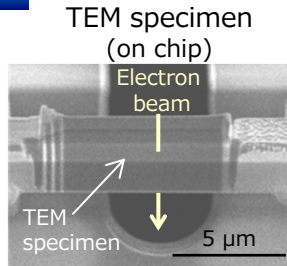
Toray Research Center developed an advanced analytical method to comprehend thermal behavior in structure and elemental composition with a spatial resolution of nm level, combining *in-situ* heating TEM and STEM-EDX techniques. In Au/Pd-P/Ni metal multilayer structure used as under bump metal (UBM) for solder bonding, we investigated a structural change in crystal grains and metal diffusion during heating process.

## 1. *In-situ* heating TEM

TEM observation under controlled thermal condition (Temp. : 23~1300°C)

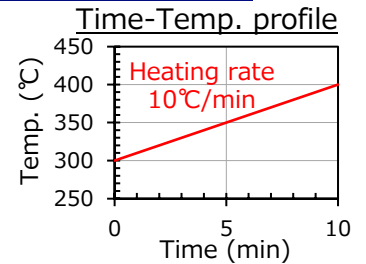
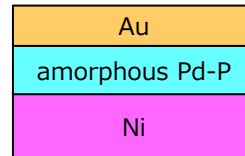
Visualization of thermal behavior at nm level

[Our Technical report: P01978, P02139]

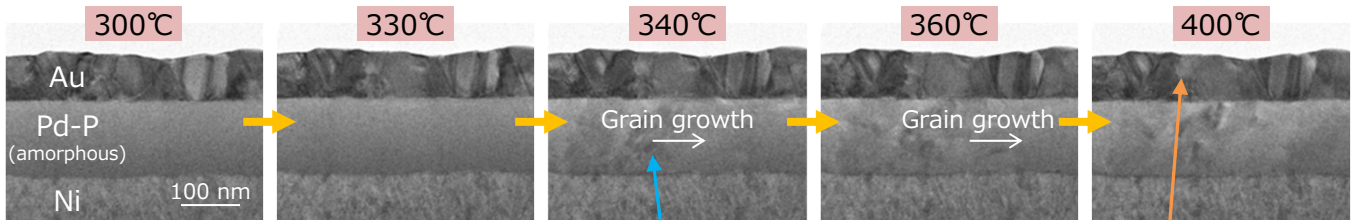


## 2. Sample / Time-Temp. profile

UBM for solder (cross-sectional scheme)



## 3. *In-situ* heating TEM observation of thermal behavior in metal multilayer (Au/Pd-P/Ni)

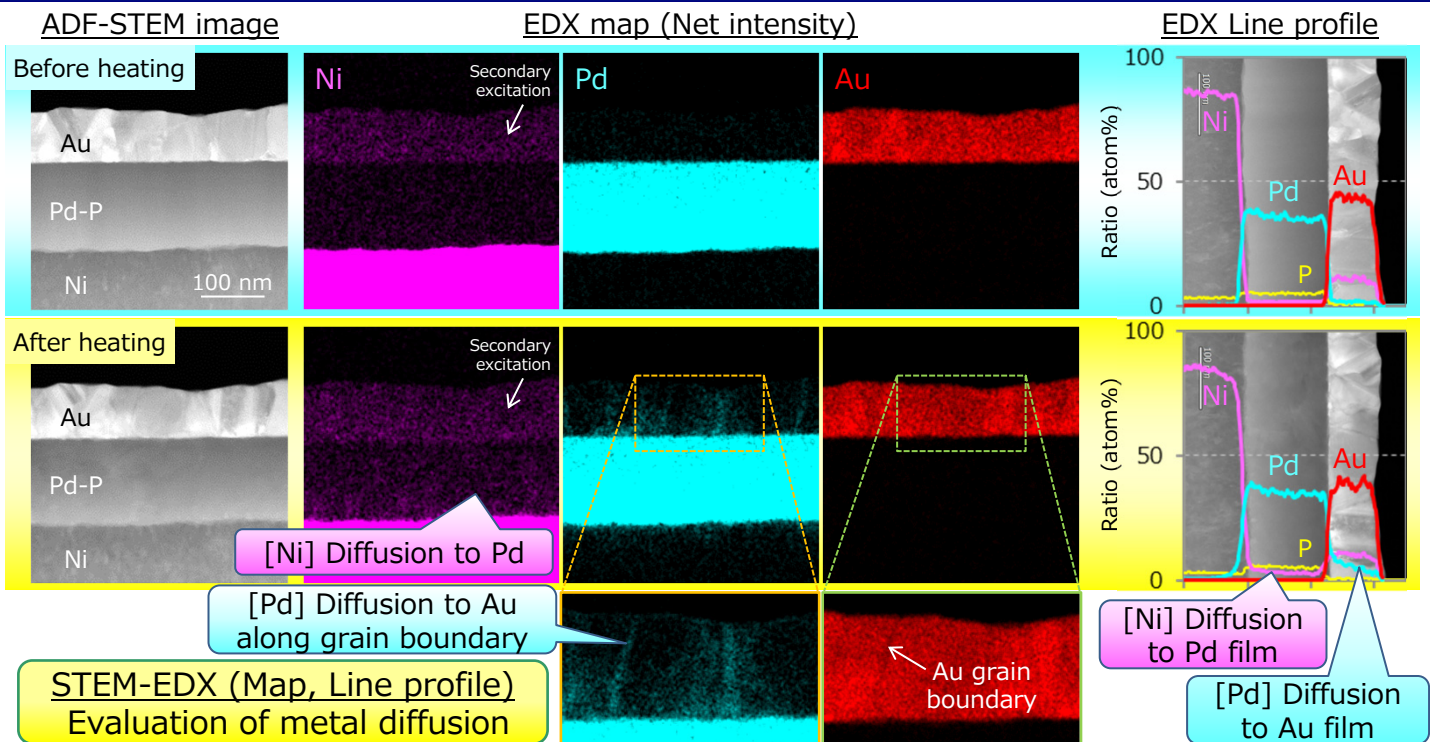


*in-situ* heating TEM  
Visualization of crystallization process

[amorphous Pd-P]  
Grain growth@340°C~

[Au] Crystal grain structural change@300~400°C

## 4. Evaluation of metal diffusion by STEM-EDX analysis before and after heating process



STEM-EDX (Map, Line profile)  
Evaluation of metal diffusion

We can offer an advanced analytical method to comprehend thermal behavior (Metal diffusion phenomenon, etc.), combining *in-situ* heating TEM and STEM-EDX.