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OMICS Group has organized 500 conferences, workshops and national symposiums across the major cities including San Francisco, Las Vegas, San Antonio, Omaha, Orlando, Raleigh, Santa Clara, Chicago, Philadelphia, Baltimore, United Kingdom, Valencia, Dubai, Beijing, Hyderabad, Bengaluru and Mumbai.

2nd International Summit on “Integrative Biology”
Aug.4-5 2014, Hilton Chicago Northbrook, USA

Novel Approach to Integrate Biocompatible MEMS by Electrodeposition Using Supercritical Carbon Dioxide

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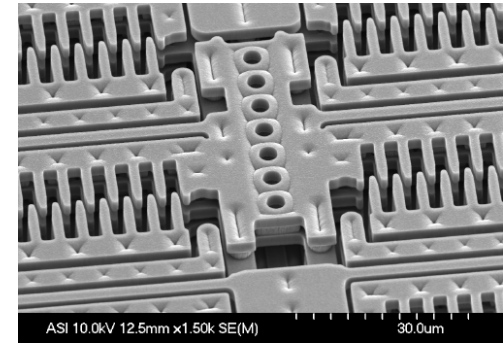


Introduction

Micro Electro Mechanical system(MEMS)

Actuator and sensor component

Silicon Substrate (semiconductor)

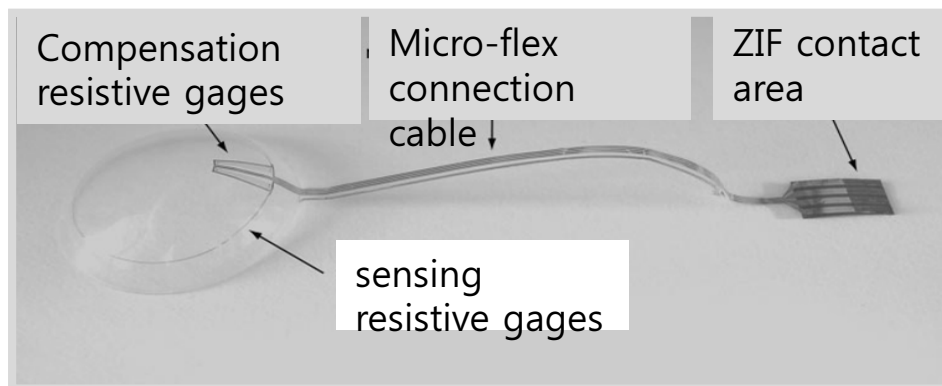


Next generation

Polymer based MEMS

Flexible, biologically compatible

Bio-Medical Micro-Devices



❖ **Sensing contact lens**

Neuro-prosthetics

Hybrid structure of Electro-devise and biosensor on polymer

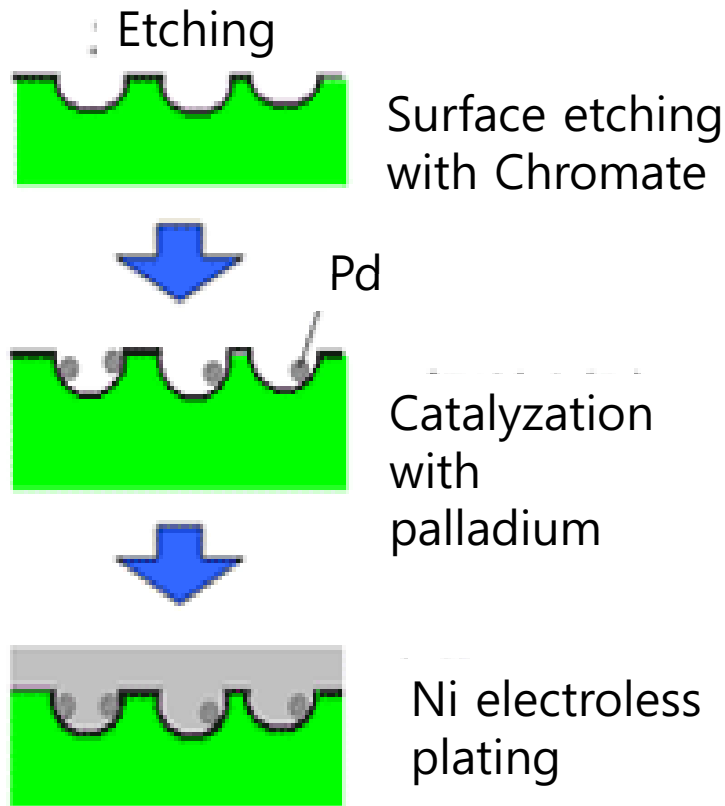
To realize Neuro-prosthetics

1. Artificial hand or leg: robotics & MEMS
2. Artificial skin : biosensor & circuit on rubber
3. Artificial neurons: circuit on polymer
- 4. Wearable electrodevice : circuit on textile**

New method to metalize on polymer;
especially on textile

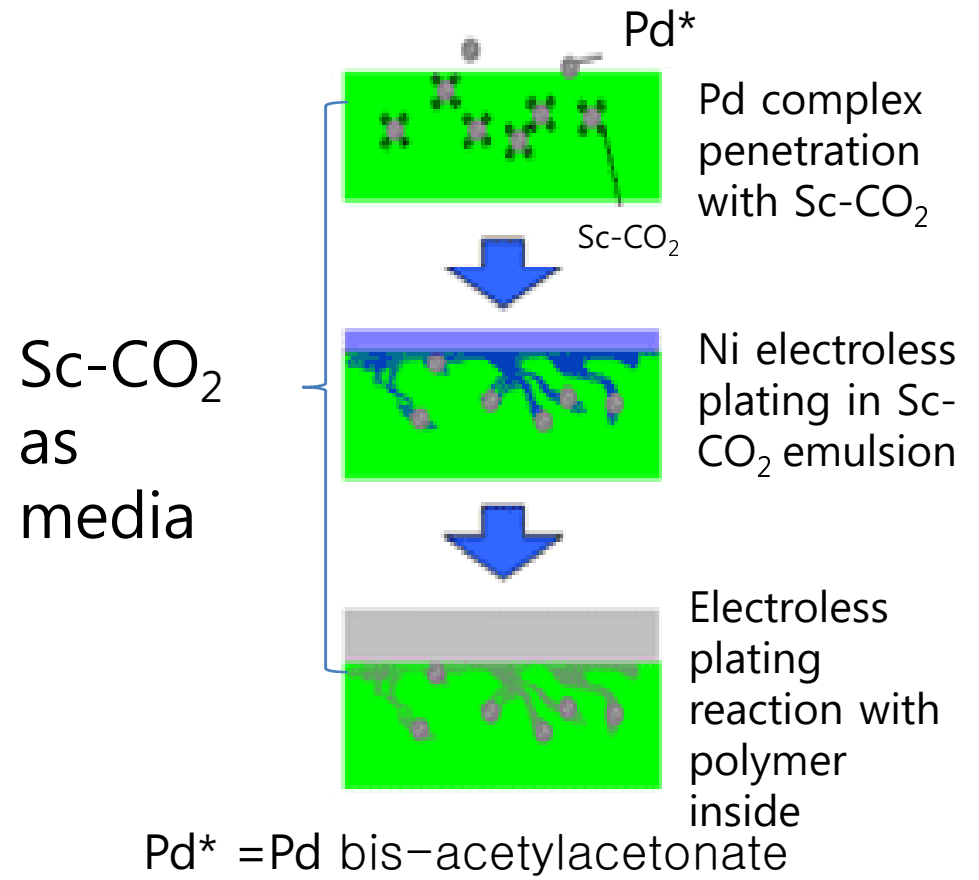
Metalizing on Polymer

Conventional electroless plating

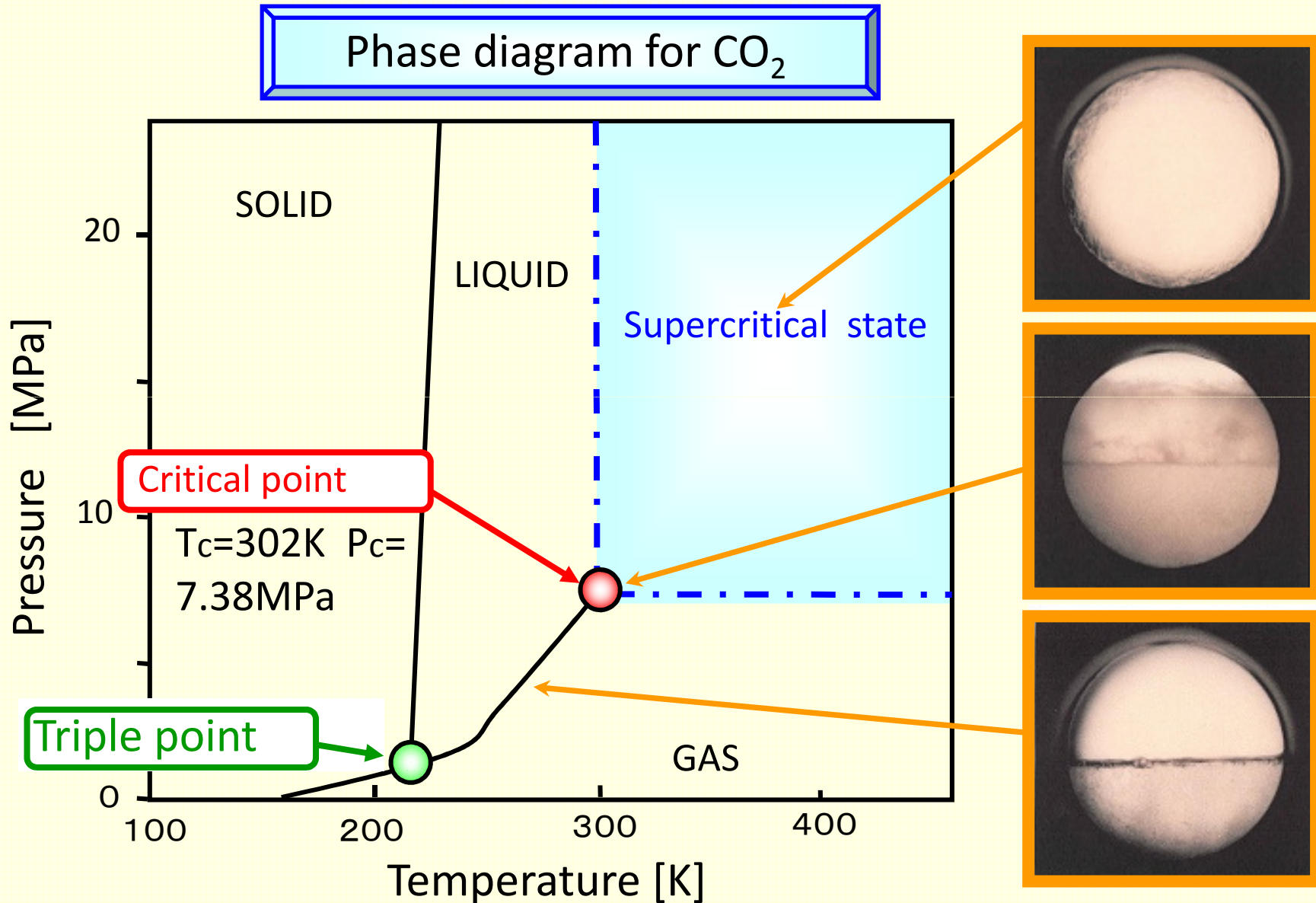


Novel method

Catalyzation in Sc-CO₂ and Electroless plating in Sc-CO₂ emulsion (ELP-SCE)



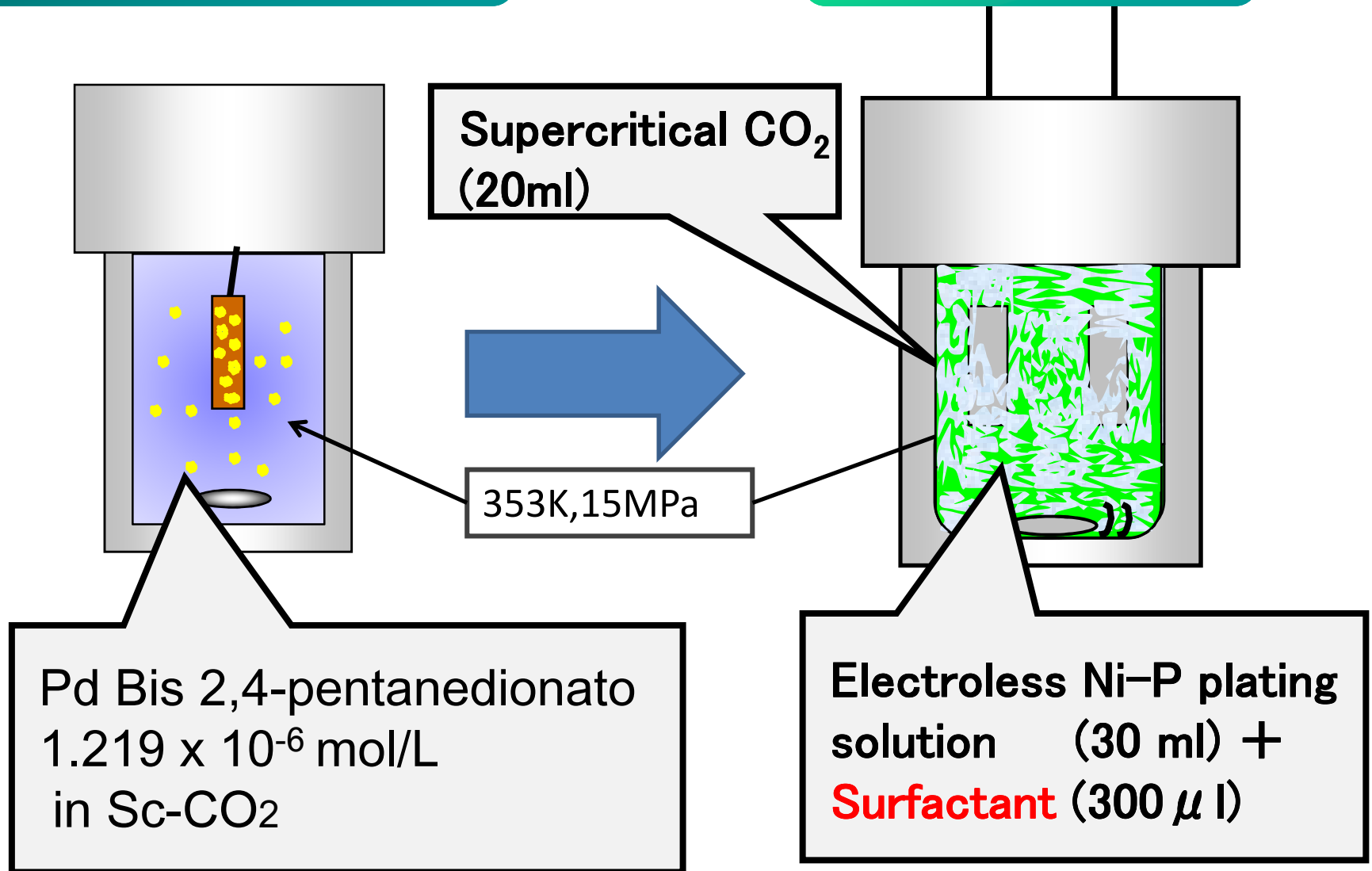
Supercritical carbon dioxide (Sc-CO₂)



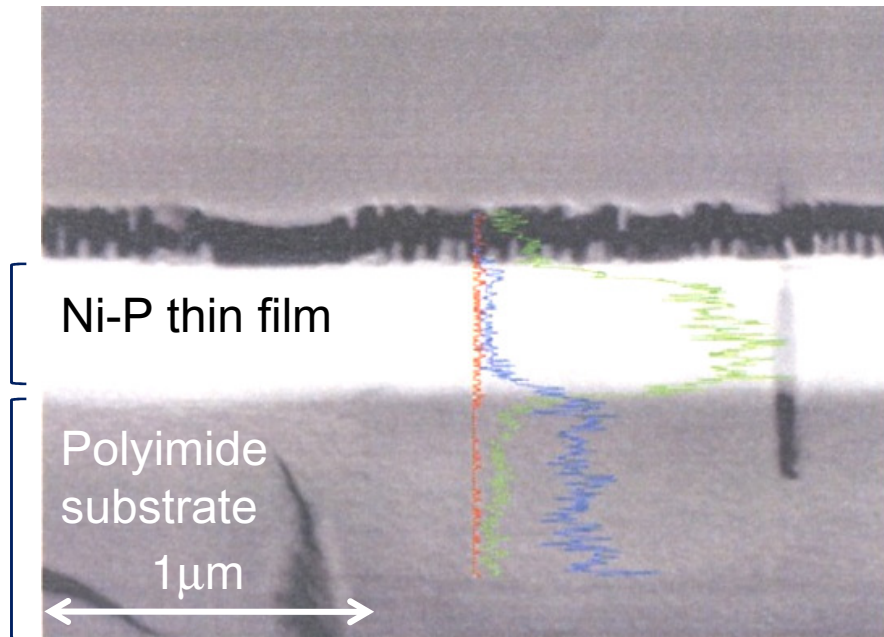
2. Electrodeposition on **Polymers by Electrodeposition Using Supercritical Carbon Dioxide**

Catalyzation in Sc-CO₂

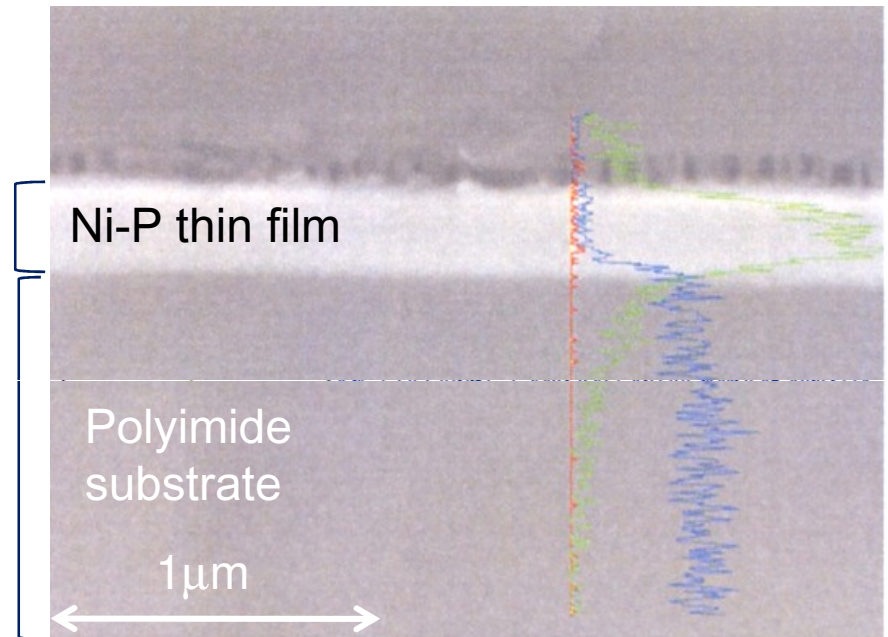
ELP-SCE



Cross-sectional atomic composition along the depth



Conventional electroless plating.



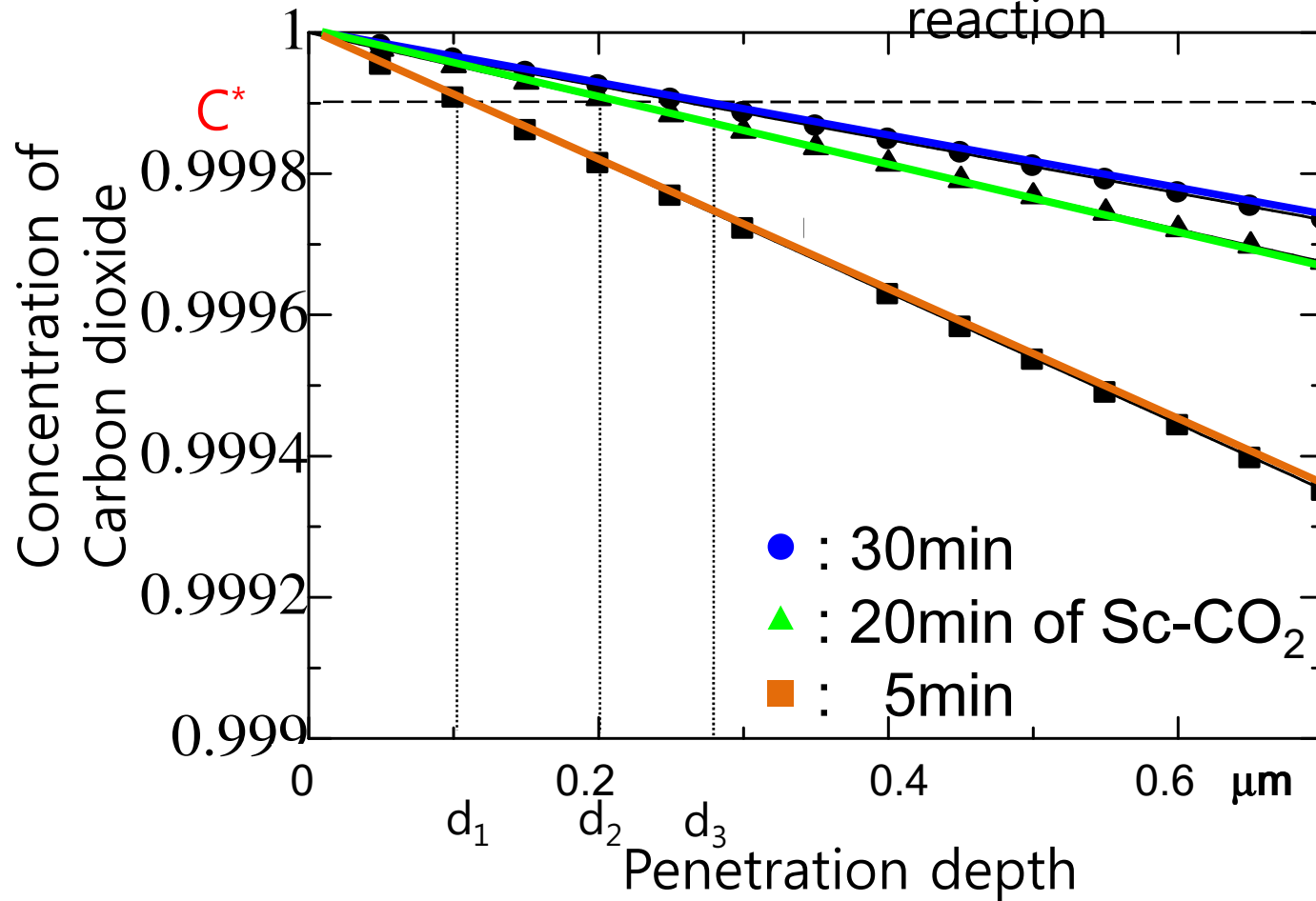
ELP-SCE

Penetrated Ni ions inside of polyimide (200nm depth)

Diffusion of Sc-CO₂

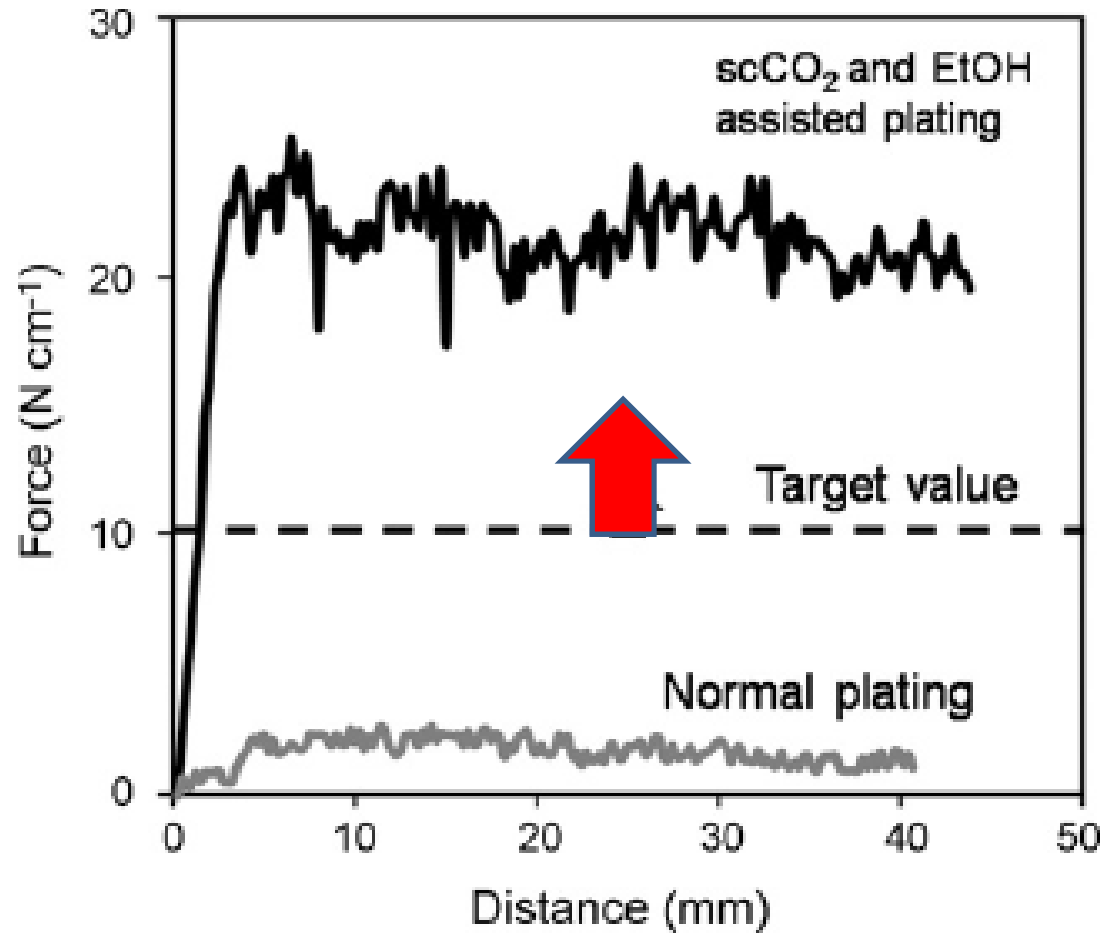
$$\frac{C}{C_0} = 1 - \operatorname{erf}\left(\frac{x}{2\sqrt{Dt}}\right)$$

C^* = critical Pd concentration for Ni-P electroless plating reaction



Pd catalyst
1.219 x 10⁻⁶
mol/L

Adhesiveness of the metal film to polymer treated by the developed method



Ref) H. Adachi, K. Taki, S. Nagamine, A. Yusa, and M. Ohshima, The Journal of Supercritical Fluids. In Press, Corrected Proof(2009).

2. Summary

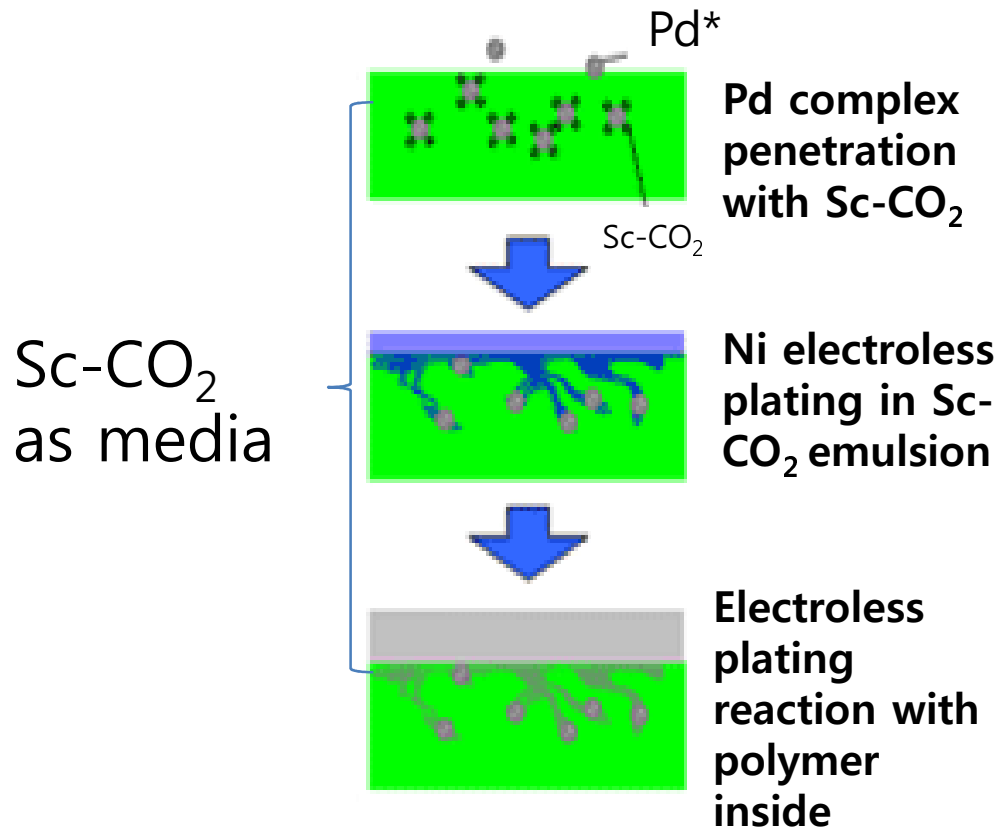
1. The depth of Ni impregnation is linearly related the square root of catalyzation reaction time in Sc-CO₂ and thus to be in conformance with Fick's second law.
(We can infinitely penetrate metal inside polymer!!)
2. High transport properties is essential for the impregnation of Ni-P into polymer and for the suppression of defects in metal on polymer.

3. Metalization on **Textiles by Electrodeposition Using Supercritical Carbon Dioxide**

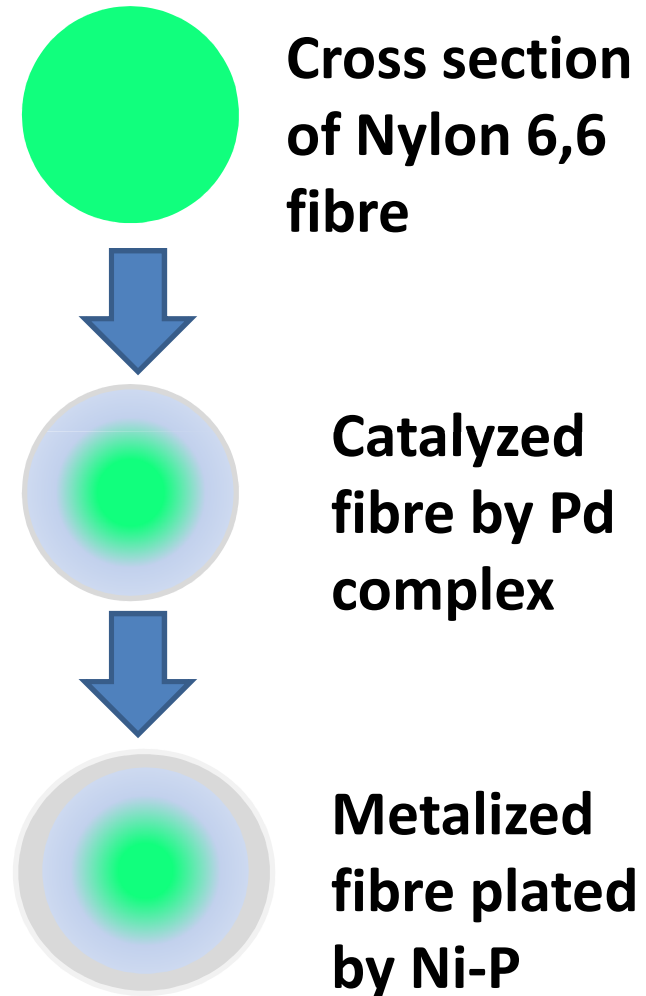
Metalization on Textile

Novel method

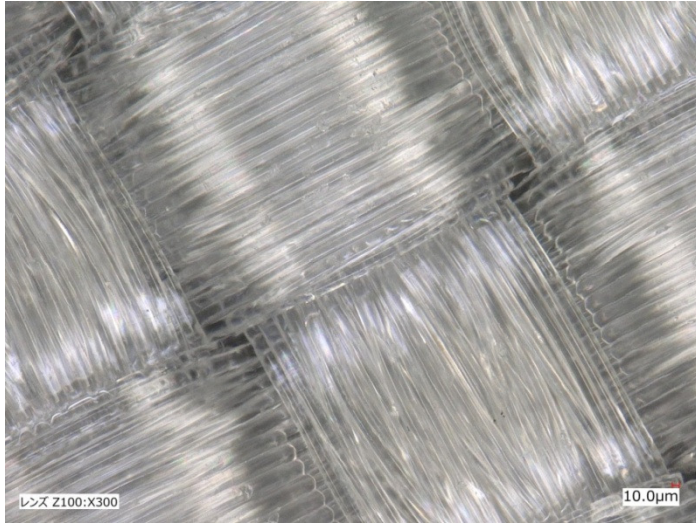
Catalyzation in Sc-CO₂ and Electroless plating in Sc-CO₂ emulsion (ELP-SCE)



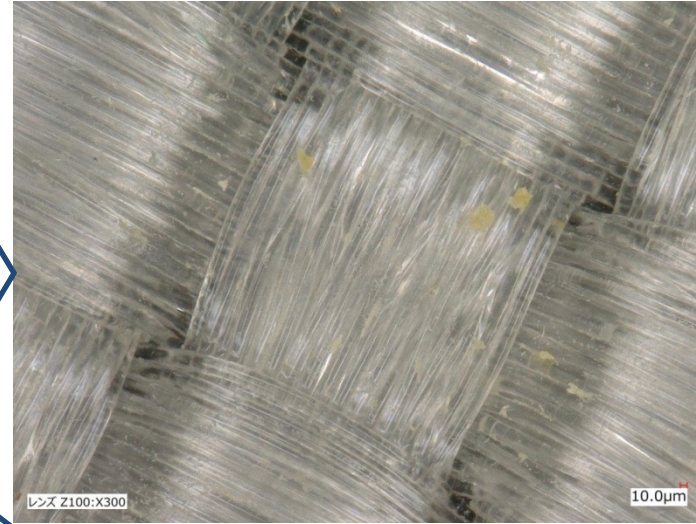
Pd* = Pd bis-acetylacetonate



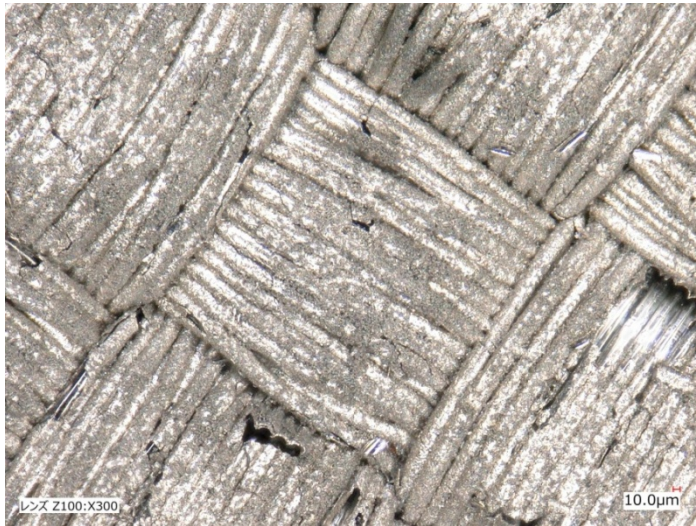
Metallization on Nylon 6,6 fibril



(a) Nylon 6,6



(b) Nylon 6,6 catalyzed in Sc-CO₂

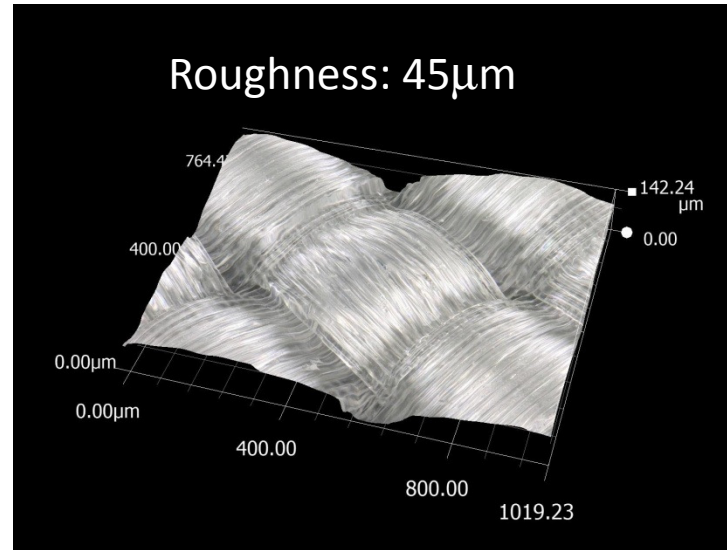


(c) Nylon 6,6 electroplated in Sc-CO₂

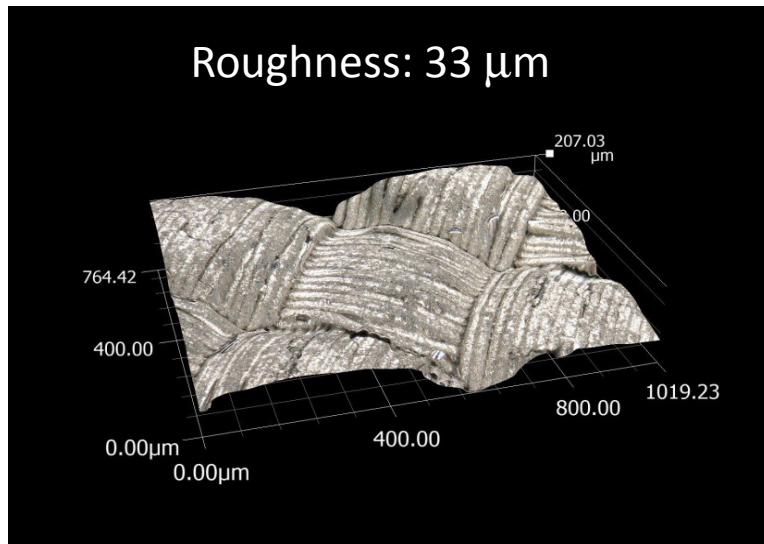


(d) Nylon 6,6 electroplated in CONV

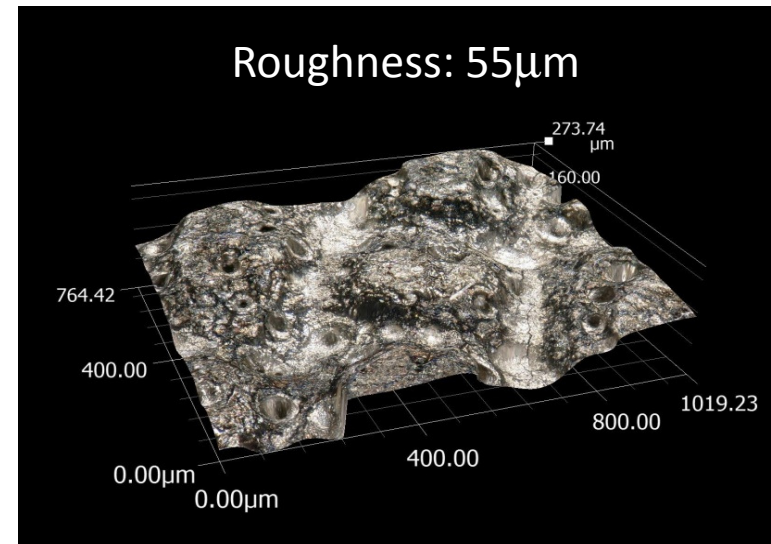
3D images of Metalized Nylon 6,6 fibril



(a) Nylon 6,6



(b) Nylon 6,6 electroplated in Sc-CO₂



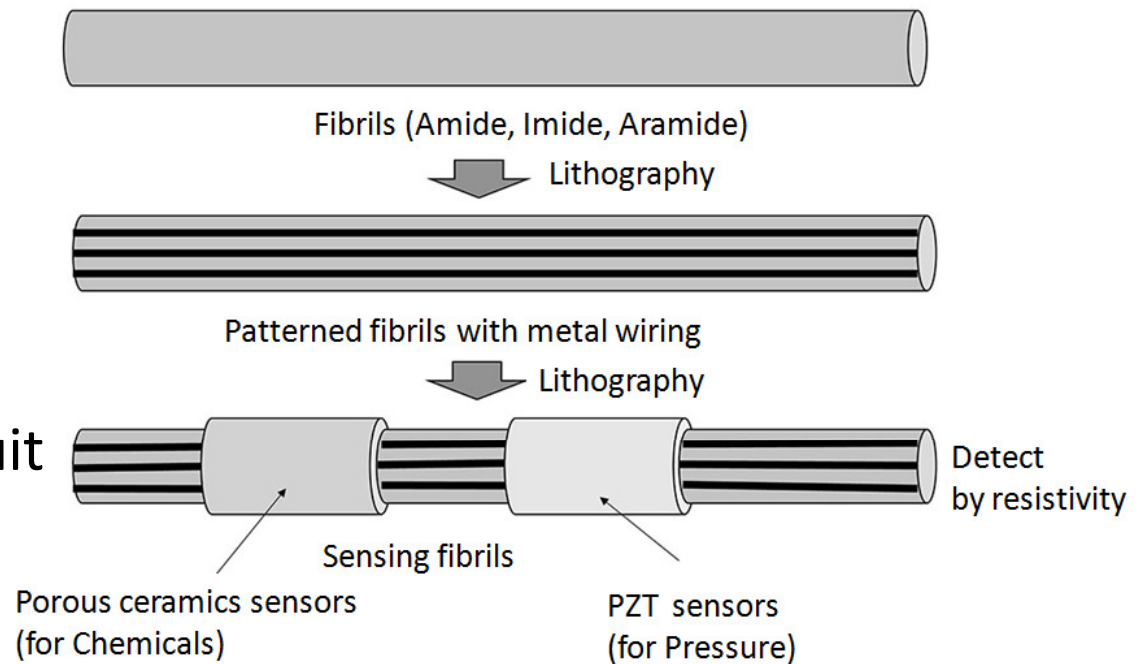
(c) Nylon 6,6 electroplated in CONV

4. Conclusions

1. Successful metallization on Nylon 6,6 textiles by using supercritical CO₂ catalyzation with Pd Bis 2,4-pentanedionato
2. Metalized fibrils via supercritical CO₂ catalyzation show the original modification of Nylon 6,6 fibrils

5. In future

1. Plating of Pt or Au on polyimide fibrils
2. Patterning of noble metal on textile
3. 3D integration of circuit on textile



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