論文 / 著書情報
Article / Book Information

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著者(和文)	CHENGPO-WEI
Author(English)	Po-Wei Cheng
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種別(和文)	論文要旨
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（博士課程）
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論 文 要 旨

THESIS SUMMARY

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学生氏名： Student's Name	Cheng, Po-Wei	審査員主査： Chief Examiner	曽根　正人

要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

As different demand for electronic devices increases, the electronic components also need to be diverse. Especially for flexible electronic components which are considered as the future electronic components and attract high attention in industrial and academic filed. Polymeric materials are mainly used in fabrication of flexible electronic components. However, low conductivity of polymeric materials is hard be applied singly. Thus, the concept of heterogeneous material integration is proposed. The issue of low electrical conductivity can be improved by the combination of metal and polymeric materials. The electroless plating is considered as the most ideal integration method. However, the conventional electroless plating exist inevitable issues like damage occurred at pretreatment step and the weak interaction between metal and polymeric materials. To avoid these issues, the supercritical carbon dioxide is used to assist electroless plating to enhance the interaction between metal and polymeric materials without damage on substrate. The low conductivity of polymeric materials is improved by Ni-P, Au and Pt deposited by using sc-CO_2 assisted electroless plating in this thesis. The interaction between metal and polymeric materials is evaluated by using tape adhesion test and tensile test.

In chapter 2, Functionalization of PET films were achieved by an electroless plating process involving a sc-CO_2 catalyzation step to demonstrate the potential in preparation of flexible catalytic electrodes. By the sc-CO_2 catalyzation, the electrical resistance of the Ni-P/PET reached 0.27 Ω after 9.0 min of the Ni-P deposition time. The electrical resistance merely changed to 0.30 Ω after the tape adhesion test, which performed contributions of the sc-CO_2 catalyzation on the reliability of the Ni-P/PET composite. Gold was deposited on the Ni-P/PET composite also by an electroless plating process, and the electrical resistance was lowered to 0.015 Ω after 60.0 min of the gold deposition. The catalytic activity

of the Au/Ni-P/PET composites in oxidation of urea, ascorbic acid and glucose were confirmed, which demonstrate the potential as flexible catalytic electrodes in biosensors.

In chapter 3, Pt metallization of PET film was successfully achieved by electroless plating with the supercritical CO_2 catalyzation step. For the as-metallized Pt/PET with 30 min of the Pt deposition time, the electrical resistance was 0.95 Ω, and the electrical resistance reduced to 0.54 Ω as the Pt deposition time prolonged to 60 min. The thickened Pt layer was the main course of the reduced electrical resistance. For the Pt/PET with 60 min of the Pt deposition, the electrical resistance merely changed to 1.09 Ω after the tape adhesion test, and the fracture strength was at 65.9 MPa. The low electrical resistances before and after the adhesion test and the high tensile strength in the Pt/PET reported in this study all revealed advantages of the sc-CO_2 catalyzation step in development of biocompatible and flexible electronics.

In chapter 4, Metallization of 3D-printed polymer structures was achieved by sc-CO_2 assisted electroless plating process to demonstrate the potential for rapid fabrication of electronic components. The electrical resistance reached 0.61 Ω after 3 min of metal deposition time, and the resistance was lowered to 0.03 Ω after 30 min of the deposition time. After the tape adhesion test, electrical resistance of the Ni-P metallized 3D-printed polymer structure merely changed to 0.04 Ω for the sample with 30 min of the deposition time.

In chapter 5, Additive manufacturing of gold metallized 3D structures was demonstrated in this study. Complete gold metallization of the 3D printed structures was realized by sc-CO_2 assisted electroless plating. For the 45.0 min sample, the electrical resistance slightly worsened to 0.18 Ω. In addition, the strengthening was observed in the gold metallized samples, and the highest fracture strength was 47.6 MPa for the 45.0 min sample. The gold metallized 3D printed structures reported in this study are promising materials toward electronic components by the low electrical resistance, resistant again the tape adhesion test, and promoted tensile fracture strength.

In chapter 6, This study demonstrated the use of additive manufacturing for gold metallized circuit production, achieved through sc-CO_2 assisted electroless plating. The roughness of the 3D-printed patterns was found to play a critical role, as the internal stress of Ni-P was leveraged to enhance the importance of roughness in adhesion. As a result, a selective pattern of gold metallization was achieved in

a convenient and efficient process.

In chapter 7, The effect of sc-CO_2 treatment on the crystallinity of PET was investigated. The crystallinity of PET could be modified based on the properties of sc-CO_2. The density of sc-CO_2 close to gas tended to facilitate plasticization, resulting in an increase in the amorphous region. Conversely, the density of organometallic compounds dissolved in sc-CO_2, similar to liquid solvent, favored the induction of crystallization. The adjustment of PET crystallinity through sc-CO_2 treatment has important implications for its properties and applications. The presence of crystallinity in PET contributes to its metallization on the polymer. By controlling the density and properties of sc-CO_2, it becomes possible to tailor the crystallinity of PET to meet specific requirements.