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Interconnecting Nanomaterials for Flexible Substrate and Direct Writing Process

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Direct write technologies provide flexible and economic means to manufacture low-cost large-area electronics. In this regard inkjet printing has frequently been used for the fabrication of electronic devices. Full advantage of this method, which is capable of reliable direct patterning with line and space dimensions in the 10 to 100 um regime, is only made with all-solution based processing. Among these printable electronic materials, silver and copper nanoparticles have been used as interconnecting materials. Specially, solutions of organic-encapsulated silver and copper nanoparticles may be printed and subsequently annealed to form low-resistance conductor patterns.

In this talk, we describe novel processes for forming silver nanoplates and copper ion complex which have unique properties, and discuss the optimization of the printing/annealing processes to demonstrate plastic-compatible low-resistance conductors. By optimizing both the interconnecting materials and the surface treatments of substrate, it is possible to produce particles that anneal at low-temperatures (<200 °C) to form continuous films having low resistivity and appropriate work function for formation of rectifying contacts.

Keywords: Cu complex, Silver nanoplate, Direct writing Process

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The developments of heavy hydrocarbon reformer for SOFC

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Heavy hydrocarbon reforming is a core technology for “Dirty energy smart”. Heavy hydrocarbons are components of fossil fuels, biomass, coke oven gas and etc. Heavy hydrocarbon reforming converts the fuels into H_2-rich syngas. And then H_2-rich syngas is used for the production of electricity, synthetic fuels and petrochemicals. Energy can be used efficiently and obtained from various sources by using H_2-rich syngas from heavy hydrocarbon reforming. Especially, the key point of “Dirty energy smart” is using “dirty fuel” which is wasted in an inefficient way.

New energy conversion laboratory of KAIST has been researched diesel reforming for solid oxide fuel cell (SOFC) as a part of “Dirty energy smart”. Diesel is heavy hydrocarbon fuels which has higher carbon number than natural gas, kerosene and gasoline. Diesel reforming has difficulties due to the evaporation of fuels and coke formation. Nevertheless, diesel reforming technology is directly applied to “Dirty fuel” because diesel has the similar chemical properties with “Dirty fuel”. On the other hand, SOFC has advantages on high efficiency and wasted heat recovery. Nippon oil Co. of Japan recently commercializes 700We class SOFC system using city gas. Considering the market situation, the development of diesel reformer has a great ripple effect. SOFC system can be applied to auxiliary power unit and distributed power generation. In addition, “Dirty energy smart” can be realized by applying diesel reforming technology to “Dirty fuel”.

As well as material developments, multidirectional approaches are required to reform heavy hydrocarbon fuels and use H_2-rich gas in SOFC. Gd doped ceria (CGO, $Ce_{1-x}Gd_xO_{2-y}$) has been researched for not only electrolyte materials but also catalysts supports. In addition, catalysts infiltrated electrode over porous $La_{0.8}Sr_{0.2}Ga_{0.8}Mg_{0.2}O3\text{-}\delta$ and catalyst deposition at three phase boundary are being investigated to improve the performance of SOFC. On the other hand, nozzle for diesel atomization and post-reforming for light-hydrocarbons removal are examples of solving material problems in multidirectional approaches. Likewise, multidirectional approaches are necessary to realize “Dirty energy smart” like reforming “Dirty fuel” for SOFC.

Keywords: heavy hydrocarbon, reforming, hydrogen, Dirty energy smart