■ Is there a nice Panacea in CMP recipe?

Haedo Jeong (丁 海島)
Pusan National University

In Greek mythology, Panacea (Greek Πανάκεια, Panakeia) was a goddess of Universal remedy. Panacea was said to have a potion with which she healed the sick. This word means 'all-healing', however denotes not just a remedy but a universal remedy and is therefore not appropriate in the context of particular illnesses, e.g. a panacea for measles. Is there a nice Panacea in CMP recipe? For a long time, colloidal silica has been used as a Panacea to polish any materials which have no special recipe. Sometimes it is fit to a work material, or not bad to another, or does not work to something special.

On the other hand, the semiconductor industry is constantly required to develop new and advanced polishing technologies to cope with newly emerging materials used in various kinds of devices. The CMP process employs mechanical and chemical removal through the use of abrasives and chemical slurries, respectively. Even though these CMP processes have been used in semiconductor fabrication, some removal mechanisms are still vague because it is nearly impossible to observe the interface between the wafer and the polishing pad during the process. Unfortunately, the CMP process is largely dependent on the engineer’s experimental dexterity for this reason. In addition, the CMP technology is faced with the challenge of how to process new electronic materials. In the CMP, the selection of an abrasive and a chemical agent determines the ability to remove material and the surface quality of the target materials. Thus, it is important to understand the material properties of the target materials and to select suitable abrasives and chemicals.

Therefore, I would like to focus on the balance between the chemical and the mechanical reaction in the CMP process and its ability to cope with a variety of electronic materials. Fig. 1 shows the classification of electronic materials. The material properties of electronic materials were classified by the combination of easy to abrade (ETA), difficult to abrade (DTA), easy to react (ETR) and difficult to react (DTR). The electronic materials focused on in this paper are classified as listed below:

ⅰ) ETA-ETR materials: Conducting materials such as Cu, Al and W, that are easily scratched by colloidal silica and are dissolved by slurry chemicals.

ⅱ) DTA-ETR materials: Insulating oxides are classified as DTA-ETR materials. It is not easy to scratch on SiO2 surface with colloidal silica; however, they are easily hydrated or oxidized by alkaline agents.

ⅲ) ETA-DTR materials: Insulating polymers that are used in ICs and microelectromechanical systems (MEMS) are ETA-DTR materials. SU-8 is an epoxy-based photoresist (PR) for micromachining applications that is a thick and both chemically and thermally stable.

ⅳ) DTA-DTR materials: Wide band gap compounds, such as SiC and GaN, are DTC-DTR materials due to their high hardness and chemically inert characteristic.

Fig. 2 shows various polishing recipes and the proper chemical and mechanical balance conditions for electronic materials. Electronic materials can be largely classified into two groups: ETR groups and DTR groups. ETA-ETR materials, which easily react with chemicals, require a high chemical reaction and light mechanical abrasion to produce a fine surface. DTA-ETR material, such as SiO2, should be polished by the mechanical abrasion of a chemically reacted layer using a soft abrasive. The DTR group is a challenging area for CMP technology due to its chemically inert characteristic. Therefore, the CMP of the DTR group largely depends on the mechanical abrasion. Mechanical abrasion with fine and hard abrasives is essential for a defect-free surface of ETA-DTR materials. The surface of DTA-DTR materials is difficult to remove through general CMP processes due to its chemical and mechanical stability. Strong mechanical stress should be applied by hard and fine abrasives on the surface of DTA-DTR materials to facilitate a good chemical reaction. Therefore, stress-enhanced CMP is suitable for a defect-free surface of DTA-DTR materials.

As a conclusion, I can say there is no Panacea in CMP recipe. At first, we need to classify electronic materials based on the balance between the chemical reaction and the mechanical abrasion in the CMP process. Then, we have to find a specific recipe to enhance CMP performance of each material by controlling chemical mechanical balance. I believe that it is naturally understood, but needs to keep in mind. Thank you for kind attention!

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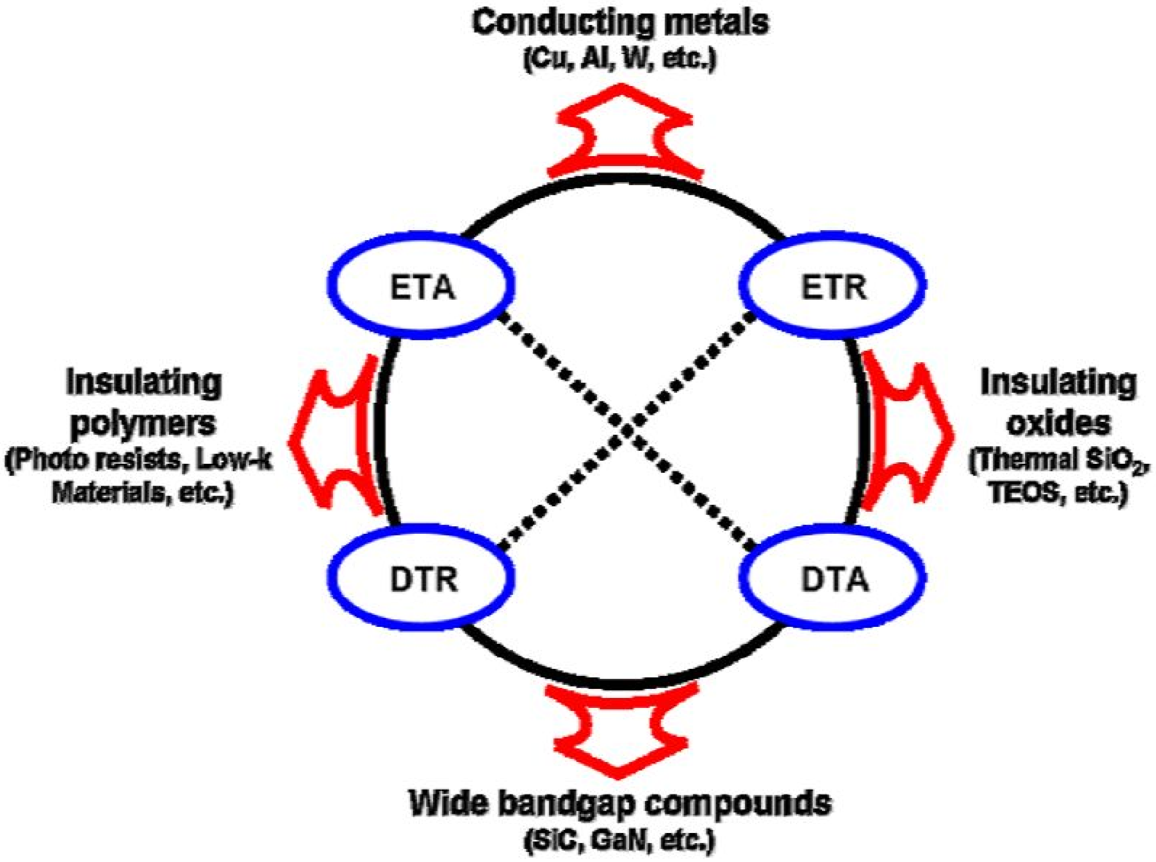

Fig. 1

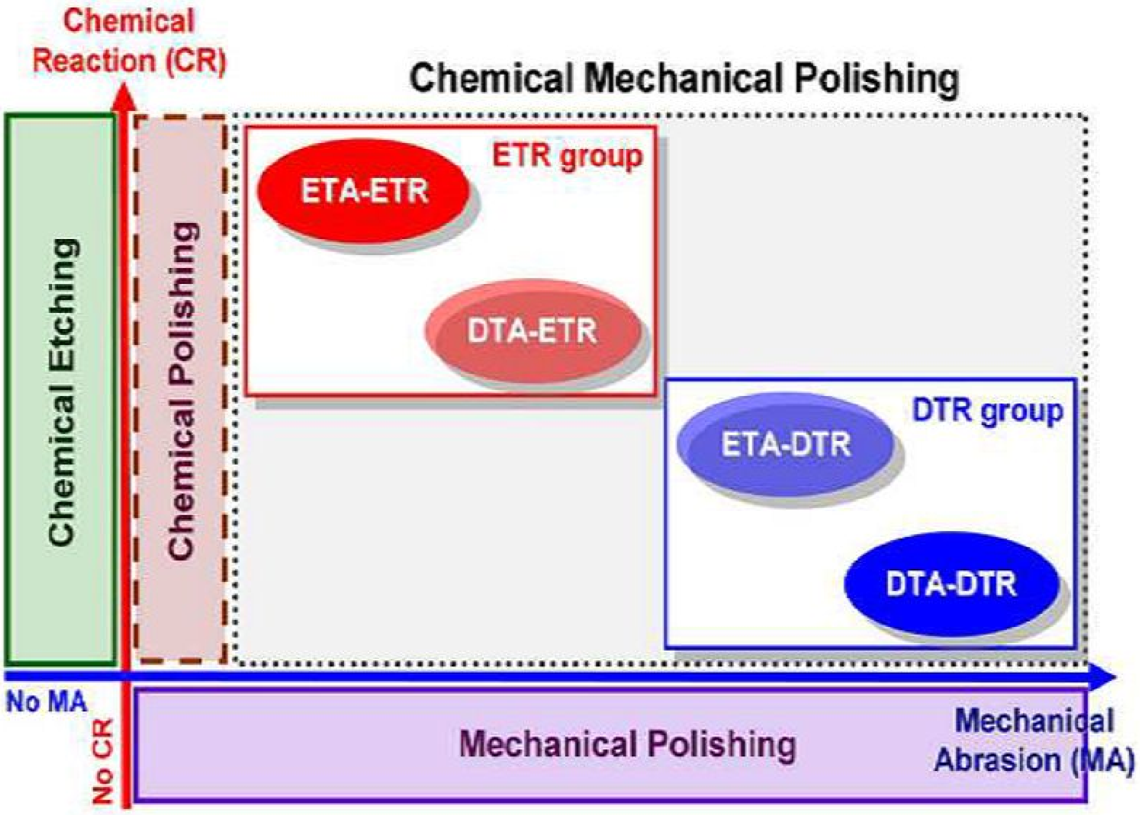

Fig. 2

Haedo Jeong (丁 海島)氏
Biography

"Haedo Jeong" received a Ph.D. degree in CMP field from University of Tokyo, Japan in 1994. He has been a Professor at Pusan National University since 1995 as a faculty member of mechanical engineering. He was also president of "Korea CMP User Group Meeting" and is an executive member of "International Conference of Planarization CMP Technology".

He established G&P Technology in 1999 to promote R&D CMP equipment. Until now, more than 100 CMP tools were supplied to domestic and overseas organizations. Recently, he is focusing on the development of CMP equipment for next generation planarization technology.