

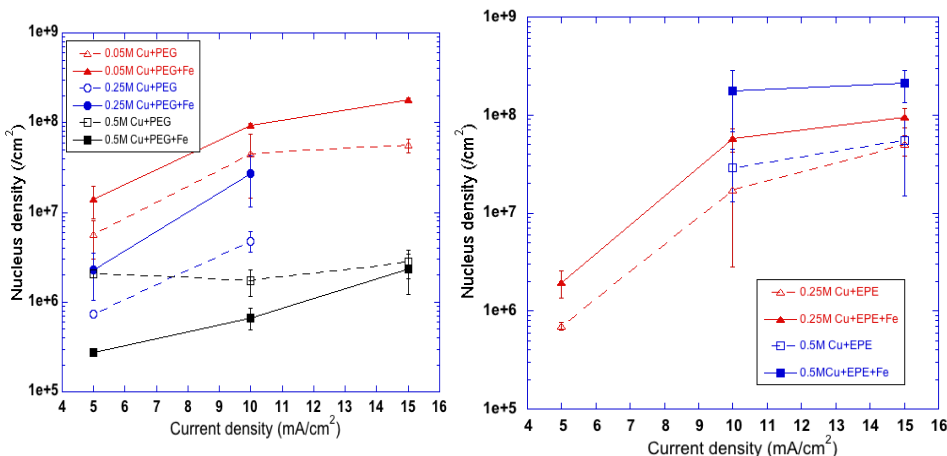
The effect of Fe(III)/Fe(II) redox couple on nucleus density during Cu electrodeposition process

Motivation: Due to the decrease in feature sizes, direct Cu electrodeposition onto barrier layer has gradually replaced that onto Cu seed layer. Achieving a high nucleus density is key to the success of direct Cu electrodeposition. Fe(III)/Fe(II) redox couple has been proved not to affect the behavior of suppressors in the plating bath and might help increase the nucleus density.

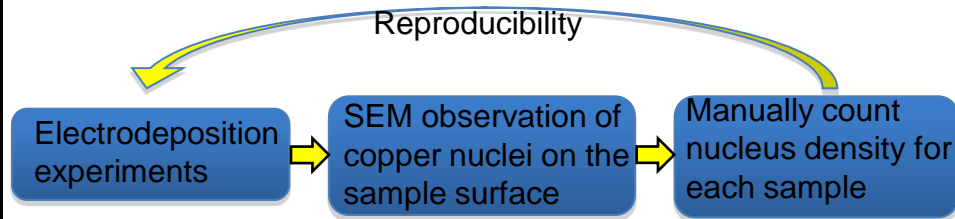
Objective: Refine chemistry to further increase nucleus density without disturbing superfill or suppression effect by suppressors.

Description of research: Conduct galvanostatic electrodeposition of Cu (Investigating different substrate materials, suppressors, CuSO₄ concentrations, current densities) and observe samples using SEM to find out the effect of Fe(III)/Fe(II) redox couple on nucleus density during Cu deposition process.

Results: Fe(III)/Fe(II) redox couple results in up to 5x increase in nucleus density for Cu electrodeposition process.



Major Challenge: A nucleus density of 10¹¹ /cm² has been achieved by industry. However, in order to form thinner Cu films, nucleus density still needs to be further increased by attempting various experimental conditions. When nucleus density is high enough, it also becomes difficult to determine the accurate value of nucleus density from usual microscopic observation such as SEM.



Primary Researcher and Contact Information:

Feng Qiao

Address: 500 W120th Street, New York, NY 10027

E-mail address: fq2117@columbia.edu

Publications:

Feng Qiao, Brendan O'Brien, Kathleen Dunn, Alan West, "The effect of Fe(III)/Fe(II) redox couple on nucleus density during Cu electrodeposition process" (accepted)

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