COMPETITIVE SURFACTANT ADSORPTION OF AOT AND TWEEN 20 ON GOLD USING QUARTZ CRYSTAL MICROBALANCE WITH DISSIPATION

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ABSTRACT

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Competitive surfactant adsorption of the anionic surfactant AOT and the nonionic surfactant Tween 20 on gold surface was investigated by using the quartz crystal microbalance with dissipation (QCM-D) at 25 °C. The adsorption isotherm of pure AOT did not reach a plateau at the CMC, but rather adsorption continued to gradually increase at concentrations higher than the CMC before reaching a plateau. This behavior is evidence of competitive adsorption between AOT and impurities. The adsorbed layer of AOT on gold became more viscoelastic as the concentration of AOT increased. Tween 20 reached the maximum adsorption on gold before its concentration reached the CMC, suggesting that the attraction between Tween 20 and gold is very strong. The Tween 20 adsorbed layer was also rigid, when compared to the AOT adsorbed layer, as indicated by low dissipation. The addition of Tween 20 to a surface covered by AOT resulted in an increase in adsorbed mass as determined by the QCM signal, suggestive of insertion of Tween 20 into the AOT adsorbed layer. This phenomenon is expected since Tween 20 will be able to separate the repulsive headgroups of AOT. However, some desorption was found for a pre-adsorbed Tween 20 layer when AOT is added. The interpretation is that some of the Tween 20 on gold was pulled by AOT to form mixed micelles in solution. Although a two-step model was applied to both AOT and Tween 20 adsorption kinetic data, AOT was found to adsorb much more slowly than Tween 20.

บทคัดย่อ

จักรกฤษณ์ ถาวร: การแข่งขันการดูดซับของสารลดแรงตึงผิวเอโอทีและทวีน 20 บนผิวทองโดยใช้เครื่องควอทซ์ คริสตัส ไมโครบาลานซ์ (Competitive Surfactant Adsorption of AOT and TWEEN 20 on Gold Using Quartz Crystal Microbalance with Dissipation)
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การศึกษาการแข่งขันการดูดซับของสารลดแรงตึงผิวชนิดประจุลบ เอโอที (AOT) และชนิดไม่มีประจุ (Tween 20) บนผิวทองโดยใช้เครื่อง ควอทซ์ คริสตัส ไมโครบาลานซ์ ที่อุณหภูมิ 25 องศาเซลเซียส ไอโซเทอมของการดูดซับของเอโอที ไม่ได้คงที่ที่ความเข้มข้นวิกฤตของการเกิดไมเซลล์ (CMC) แต่มีแนวโน้มเพิ่มขึ้นเรื่อยๆ ตามความเข้มข้นที่ขึ้น ก่อนที่เส้นกราฟจะคงที่หลังจากความเข้มข้นวิกฤตของการเกิดไมเซลล์ พฤติกรรมนี้แสดงถึงการแข่งขันกันระหว่างเอโอทีและสิ่งเจือปนในสารละลาย โครงสร้างของเอโอทีบนผิวทองมีความยืดหยุ่นมากขึ้นเรื่อยๆ ตามความเข้มข้นของสารละลายเอโอทีที่เพิ่มขึ้น การดูดซับของทวีน 20 บนผิวทองถึงจุดอิ่มตัวก่อนค่าความเข้มข้นวิกฤตของการเกิดไมเซลล์ เพราะแรงดึงดูดระหว่างทวีน 20 กับทองมีความแข็งแรง โดยที่โครงสร้างของทวีน 20 บนผิวทองมีความแข็งมากกว่าโครงสร้างของเอโอที การดูดซับของทวีน 20 บนผิวทองที่ถูกปกคลุมด้วยเอโอที นำไปสู่การเพิ่มขึ้นของมวลรวมบนผิวทอง เนื่องจากการแทรกตัวของทวีน 20 ลงในชั้นโครงสร้างของเอโอที ปรากฏการณ์นี้เกิดขึ้นได้เพราะทวีน 20 สามารถลดแรงผลักระหว่างประจุส่วนหัวของเอโอที อย่างไรก็ตามการคลายซับของทวีน 20 ที่ถูกปกคลุมอยู่บนผิวทองนั้นเกิดขึ้นเมื่อสารละลายเอโอทีถูกเติมเข้าในระบบ โดยที่ทวีน 20 ถูกดึงออกจากผิวทองโดยเอโอทีเพื่อไปสร้างไมเซลล์ผสมระหว่างเอโอทีและทวีน 20 ในสารละลาย ข้อมูลด้านความเร็วในการดูดซับของเอโอทีและทวีน 20 บนผิวทองถูกคำนวณโดยสมการการดูดซับแบบ 2 ขั้น โดยความเร็วในการดูดซับของเอโอทีช้ามากเมื่อเปรียบเทียบกับทวีน 20

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