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Modification of aluminum surfaces with superhydrophobic nanotextures for enhanced food safety and hygiene

Jun Kyun Oh [a,†], Shuhao Liu [b,†], Matthew Jones [a], Yagmur Yegin [c], Li Hao [d], Tamra N. Tolen [e], Nirup Nagabandi [a], Ethan A. Scholar [a], Alejandro Castillo [e], T. Matthew Taylor [e], Luis Cisneros-Zevallos [f], Mustafa Akbulut [a,b,*]

[a] *Artie McFerrin Department of Chemical Engineering, Texas A&M University, College Station, TX 77843, USA*
[b] *Department of Materials Science and Engineering, Texas A&M University, College Station, TX 77843, USA*
[c] *Department of Nutrition and Food Science, Texas A&M University, College Station, TX 77843, USA*
[d] *College of Chemistry and Chemical Engineering, Zhongkai University of Agriculture and Engineering, Guangzhou 300072, China*
[e] *Department of Animal Science, Texas A&M University, College Station, TX 77843, USA*
[f] *Department of Horticultural Sciences, Texas A&M University, College Station, TX 77843, USA*

* Corresponding author. *E-mail address:* makbulut@tamu.edu (M. Akbulut).
† Both authors contributed equally to this work.

Abstract

As a result of frequent outbreaks occurring due to poor hygiene and improper sanitation of processing environments, there has been an increasing demand for the development of food-contact surface materials that intrinsically inhibit and reduce likelihood of potential microbial adherence and biofilm formation. Herein, we report the synergistic utilization of surface nanotexturing and chemical modifications with nonpolar functional groups on aluminum surfaces to produce coatings having bacterial super-repellant and mud anti-fouling characteristics. Using these coatings, the attachment of *Salmonella* Typhimurium LT2 and *Listeria innocua* as pathogen surrogates was reduced more than 99.0%, compared to the bare aluminum surfaces. In addition, the coating strongly resisted the adhesion of mud, showing a 10-fold reduction in the area of mud adhesion upon submerging in mud solution. Moreover, this method is both versatile and scalable, involving inert and biocompatible building blocks. Overall, this study contributes to the field of food safety through the design and development of novel coatings for achieving improved food safety and hygiene.

Keywords: Food safety, Pathogens, Cross-contamination, Anti-adhesion, Food-contact surfaces, Aluminum

Highlights

- Biocompatible silica-based superhydrophobically-modified aluminum surfaces were developed.
- Attachment of *Salmonella* Typhimurium LT2 and *Listeria innocua* was reduced by >99.0%.
- Superhydrophobically-modified aluminum surfaces exhibited excellent mud-repelling activity.
- Bacterial anti-adhesion properties are attributed to weak intermolecular interactions.
- The proposed surface modification method can be applied to metal food-contact surfaces.