Beitrag ID: **5** Typ: **Poster**

Electrical Discharge of Sliding Drops

Montag, 4. Dezember 2023 18:10 (20 Minuten)

Water drops moving on many surfaces experience electrical charge separation. This process leads to opposite charging of the surfaces and drops, which changes properties of this system. Electrostatic forces affect the dynamic contact angles and sliding velocity of drops.[1] In addition, charges on the surface decreases its surface energy. Recently, charging of water drops inspires many researchers to design power generation devices and drop manipulation strategies.[2,3] Current research focuses mainly on the generation and accumulation process of charges. However, how do charged drops discharge?
We designed substrates with heterogeneous permittivity properties and coated them with an electrical insulating hydrophobic polymer. When a charged drop approaches the high permittivity substrate area, the electric field strength at the contact line exceeds the dielectric strength of the polymer coating. The latter leads to partial discharge of the drop. The discharge of the drop is associated with the formation of a Taylor cone at advancing contact line, resulting in a sharp decrease of advancing contact angle. Then, as the discharge process ends, the charges in the drop returns to zero. At the same time the Taylor cone, the local electric and the electrostatic force acting on the drop disappear. The dynamic contact angles are no longer affected by Maxwell stress and increase again. After the drop discharged, the charge separation at the receding contact line is enhanced. Thus, locally more charges are present, which increases the surface energy effectively.
The above chare-discharge-charge behaviour of the initial drop at the high permittivity substrate area affects the charging and sliding behaviour of subsequent drops. Controlling the charging and the discharging behaviour locally, allows us to manipulate drops. Understanding the discharging behaviour of sliding drops is the basis to improve slide electrification processes.

[1] Li, X. et al. Spontaneous charging affects the motion of sliding drops. Nature Physics 18, 713-719 (2022).
[2] Sun, Q. et al. Surface charge printing for programmed droplet transport. Nature Materials 18, 936-941 (2019).
[3] Xu, W. et al. A droplet-based electricity generator with high instantaneous power density. Nature 578, 392-396 (2020).

Hauptautor: NI, Zhongyuan (Max Planck Institute for Polymer Research)

Co-Autoren: LI, Xiaomei; BERGER, Rüdiger; Prof. BUTT, Hans-Jürgen

Vortragende(r): NI, Zhongyuan (Max Planck Institute for Polymer Research)

Sitzung Einordnung: Poster Session