

Gecko spatulae supplement electrostatic attraction by dust nanoparticles

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“The limited number of dust nanoparticles available on typical room surfaces to support gecko weight is supplemented by the more than 600 million spatulae.”

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Background Prior gecko electrostatics was based on the premise that dust nanoparticles (NPs) are ubiquitous and attach in large numbers to walls and ceilings. NP detachment by spatula located at the tip of toe-hairs was shown to produce electromagnetic (EM) radiation that by the photoelectric effect produced charge, thereby allowing the gecko to walk on room surfaces by electrostatic attraction. About 45 million <100 nm dust NPs were shown necessary to support the gecko weight. However, surface concentrations inferred from typical volumetric concentrations in room air suggest the necessary number of NPs may not be available to support the gecko on diverse surfaces. Because of this, the electrostatic attraction induced as the spatulae alone contact the room surface was investigated.

Electrostatic Spatulae Mechanism The EM confinement of the spatulae atoms differs from the dust NPs. The confinement of the spatulae idealized as a thin circular disk centrally supported on the stalk is based on an extension of a principle first proposed by John Tyndall in the 1870's. Tyndall's principle of EM confinement relies on the properties of a dielectric (non-conducting) medium surrounded by another dielectric material of lower refractive index. Indeed, the spatulae is surrounded by air except at the interface with the stalk, the latter shown to act like a mirror to provide the EM confinement of the kT energy of spatulae atoms. Unlike the dust NPs, EM confinement occurs without physically detaching the spatulae from the stalk. See www.nanoqed.org at link "Gecko Update"

Thermal kT energy is recovered as the spatulae contact room surfaces while detachment induces the emission of VUV radiation that charges the spatulae. Provided the surface is macroscopic that by quantum mechanics is allowed to have $kT > 0$, only contact is necessary to recover the kT energy of spatulae atoms. Thermal response is prompt because of the nanoscale thickness of the circular disk. Upon detachment, the EM confinement requires the kT energy to vanish with conservation proceeding by the spatulae emitting VUV radiation. By the photoelectric effect, the VUV induces the surface to lose electrons and charge positive with the electrons charging the spatulae negative. The gecko is therefore held to the room surface by the spatulae induced electrostatic force to significantly supplement that induced from dust NPs.

Conclusions Gecko charging by detaching dust NPs with toe-hairs is limited by the availability of NPs on diverse wall and ceiling surfaces. However, the more than 600 million spatulae attached to the gecko toe-hairs are shown to induce electrostatic attraction upon contact with the room surfaces to more than compensate for available dust NPs allowing gecko weight to be easily supported.

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For more information:

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