New study challenges centuries-old Amontons' laws of friction

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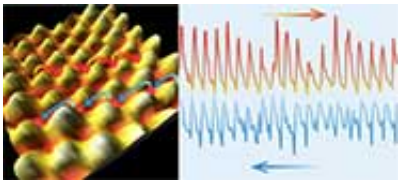

(Phys.org) —The frictional characteristics of nanotextured surfaces cannot be fully described by the framework of Amontons' laws of friction, according to new research from the University of Bristol, published in *ACS Nano*.

Nanostructured surfaces are increasingly used in modern miniaturised devices, where nanosized surface features with well-defined geometry and dimensions are incorporated for tailored functionality and properties. It is thus crucially important to understand frictional properties of such nanostructured surfaces.

In order to assess friction data obtained on nanostructured surfaces, scientists have hitherto resorted to the laws of friction described by French physicist Guillaume Amontons in 1699 – particularly the concept of friction coefficient (that is, the ratio between friction and applied load) devised for interpreting the phenomenological macroscopic

frictional behaviour of rubbing surfaces.

From violin playing to earthquakes, stick-slip frictional behaviours are widespread in macroscopic phenomena. Using a nanosized AFM (atomic force microscope) tip to scan across a nanodomed surface, the Bristol researchers revealed sustained stick-slip frictional instabilities under all the velocity and load regimes studied. A linear dependence between the amplitude sf of these frictional oscillations and the applied load was found, leading to the definition of the slope as the stick-slip amplitude coefficient (SSAC).

The scientists thus propose that the frictional characteristics of nanotextured surfaces cannot be fully described by the framework of Amontons' laws of friction, and that additional parameters (for examples sf and SSAC) are required when their friction, lubrication and wear properties are important considerations in related nanodevices.

More information: 'Sustained Frictional Instabilities on Nanodomed Surfaces: Stick–Slip Amplitude Coefficient' by Benoit Quignon, Georgia A. Pilkington, Esben Thormann, Per M. Claesson, Michael N. R. Ashfold, Davide Mattia, Hannah Leese, Sean A. Davis and Wuge H. Briscoe in *ACS Nano*: pubs.acs.org/doi/abs/10.1021/nn404276p

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