chosen an easier way (production of consumer goods) and only each eighth enterprises has made efforts to organize the production of advanced machinery and equipment.

This brings up the need for governmental management over innovations despite the fact that market conditions call for decrease in the State regulation of innovations and for a limited role of the State in distributing resources and in selecting ways of development science and technology.

NANOTRIBOLOGY: MICROSCOPIC MECHANISMS OF FRICTION

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Friction is one of the oldest problems in physics with a huge practical significance. For example, Persson presented the following impressive estimation: in the USA friction takes away 6% of the gross national product, that is >$700 billion per year. So, it is not surprising that the main friction laws, the famous Amontons' laws, belong to the oldest physical laws and are known already for more than three hundred years. However, a physical explanation of the empirical Amontons' laws was given by Bowder and Tabor as late as the middle of the 20th century. A new era in tribology began at the end of the 20th century, when this science approached a microscopic and even atomic level in the study of the contacts themselves. This approach rapidly expanded due to the development of new experimental techniques such as the atomic-force microscope (AFM), the friction-force microscope (FFM), the surface-force apparatus (SFA), and the quartz-crystal microbalance (QCM) able to perform experiments on well-characterized model systems at the nanoscale. At the same time, the evolution of powerful computers allowed detailed simulations of friction processes on the atomic scale.

Tribology is the science of surfaces in relative motion. It is of great theoretical interest and huge practical significance.

In the present review I describe the modern state of the problem from the point of view of surface science physicists. The main accent is devoted to recent MD results in their connection with experiments.

First of all, one has to distinguish two physically different frictional phenomena: the static friction and the kinetic friction. The static frictional force fs is defined as a minimal force needed to initiate sliding. Its value is determined by the atomic structure of the sliding interface and the adhesion interactions. To initiate the sliding, one has either to break interatomic bonds or to initiate a plastic flow at an interface, and it is clear that this process will occur first at some "weak" places.

The kinetic frictional force fk is the force needed to keep two substrates sliding. Actually, the kinetic friction has to be considered as a mechanism to convert the energy of translational motion into heat. Therefore, the value of fk is determined by the rate of excitation of various degrees of freedom

Both static and kinetic frictions are highly important in applications, and in different situations either a high or low value of friction is desired. Without static friction we would not be able to walk and cars to move. A high static friction is necessary to keep stable mechanical constructions connected by bolts and nuts.

A low static friction is desired in moving parts of machines, e.g., car engines, and the zero value of fs achievable with liquid lubricants would be the best solution.

However, in some cases we need a high kinetic friction, e.g., between the road and the

tyres when braking the car, or when lighting a fire by rubbing wood on wood as ancient people did (the latter is in fact an example of a tribochemical reaction).

One should distinguish between two different regimes, the hydrodynamic (liquid) friction and the boundary lubrication. In the former case, the substrates are separated by a thick (e.g., &0.01 mm) liquid lubricant film. The physical problem in this case reduces to solution of the Navier–Stokes equation of hydrodynamics with appropriate boundary conditions and geometry of the contact, and the kinetic friction is determined mainly by the viscosity of the liquid lubricant (Reynolds, 1886). In the present article we discuss only the case of boundary lubrication, when the substrates are separated by a thin (a few atomic diameters) lubricant film. The case of "dry friction" also belongs to this class. The boundary lubrication is obviously the most important in micromachines. However, even in the macromachines where the hydrodynamic friction operates typically, the boundary lubrication is also important at stop/start moments, when the lubricant is squeezed out from the contact area and the surfaces come into direct contact.

Because tribology is an extremely important branch of material science, at least several review papers are published every year. Some of the works are devoted mainly to tribological experiments, others are more concentrated on theoretical or simulation aspects of the problem. In any case I cannot claim to present a whole picture of the problem. My goal in this work is to give sight into the problem from physicists working in surface science and, moreover, mainly on theoretical approaches based on molecular dynamics (MD) simulations and using simple physical models.

THE USE OF NEWTON'S METHOD FOR LINEAR PROGRAMMING

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Continuous and discrete versions of the barrier-Newton method for linear programming are considered. This primal-dual method is based on the use of Newton's method to find points in the direct and dual spaces which satisfy a consistent system of optimality conditions. The local and non-local properties of the method are investigated. In the discrete versions of the method, the steps used in the direct and dual spaces are different. When the steps are chosen by certain rules, the method converges at superlinear and quadratic rates. In one version of the method the steps are chosen from the condition of steepest descent, and a range of initial conditions for which not more than two iterations are required is identified.