Ecology and Industrial Technologies

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Wear regularities of the cutting and deforming tools

The quality and productivity of cutting machining and plastic deformation both in the cold and hot conditions are provided by the tools performance capacity of the tools in high friction and wear.

The major type of instrument destruction is wearing, because it is systematic, unlike breakages and chipping of the working part. That is why we must assume the wear resistance and friction heat resistance are the most important criteria of performance capacity. They are characterized by wear and wearing rate, temperature and friction coefficient, etc.

A differential analysis was conducted. The analyzed aspects included wearing types of the cutting and deforming tools and their quantitative assessment in view of the cutting speed, the location of the contact surfaces in reference to the cutting zone (deformation) on research results basis of various instruments wear testing[1,2].

The analysis allowed the following conclusions.

The major types of wearing at low cutting speeds were adhesive and abrasive wearing. Adhesive wearing predominated. The quantitative relation wearing types was approximately 75% and 25%.

The major types of wearing at high cutting speeds, were adhesion wearing, abrasion wearing and diffusion wearing, but the share of the adhesive wearing was the largest. The quantitative relation wearing types was approximately 65%, 25% and 10%.

Adhesion wearing and abrasion wearing prevailed on the front and rear surfaces of cutting tool. The adhesion wearing dominated on the both surfaces and the relation wearing types was approximately 80% and 20% on the front surface, 70% and 30% on the rear surface.

The analysis based on the methodology described in [3], allowed to establish a cause-effect relationship in quantitative terms between the types and causes of wearing.

If the general wear is taken for 100%, about 70% constitute the adhesion wearing, and no more than 30% the abrasive wearing (see the above). The cause of the adhesive wearing is adhesion grip followed by the tearing of tools material [1]. The results of the conducted analysis are the following. General wear includes 70% of adhesion grip. In abrasive wearing, according to [1], there are two reasons which are manifested in nearly equal percentage. They are the following:

a) the adhesion grip with the formation of a separating solid scratching abrasives (about 15%);

b) the scratching of tool by the solid inclusions that are in the treated materials (about 15%).

Since the total share of the causes of adhesive wear abrasive wearing includes the reason for adhesive grip, in overall process of wear will constitute not 70%, but 85%.

Thus, these results show that to evaluate and improve the resistance of tool materials in high friction and wearing condition it is vital to consider the nature of the adhesion grip.

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Nanotechnologies in present-day life. Spheres of application and prospects of development

Nanotechnology is the study of manipulating matter on an atomic and molecular scale. Generally, nanotechnology deals with developing materials, devices, or other structures possessing at least one dimension sized from 1 to 100 nanometres. There is much debate on the future implications of nanotechnology. Nanotechnology may be able to create many new materials and devices with a vast range of applications, such as in medicine, electronics, biomaterials and energy production. On the other hand, nanotechnology raises many of the same issues as any new technology, including concerns about the toxicity and environmental impact of nanomaterials, and their potential effects on global economics.

Modern synthetic chemistry has reached the point where it is possible to prepare small molecules to almost any structure. These methods are used today to manufacture a wide variety of useful chemicals such as pharmaceuticals or commercial polymers. This ability raises the question of extending this kind of control to the next-larger level, seeking methods to assemble these single molecules into supramolecular assemblies consisting of many molecules arranged in a well defined manner.

As for tools and techniques there are several important modern developments. The atomic force microscope (AFM) and the Scanning Tunneling Microscope (STM) are two early versions of scanning probes that launched nanotechnology. There are other types of scanning probe microscopy, all flowing from the ideas of the scanning confocal microscope developed by Marvin Minsky. The tip of a scanning probe can also be used to manipulate nanostructures (a process called positional assembly). Various techniques of nanolithography such as optical lithography, X-ray lithography, electron beam lithography or nanoimprint lithography were also developed. Another group of nanotechnological techniques include those used for fabrication of nanotubes and nanowires, those used in semiconductor fabrication such as deep ultraviolet lithography, electron beam lithography, focused ion beam machining, nanoimprint lithography, atomic layer deposition, and molecular vapor deposition. Atomic force microscopes and scanning tunneling microscopes can be used to look at surfaces and to move atoms around. By designing different tips for these microscopes, they can be used for carving out structures on surfaces and to help guide self-assembling structures. However, new therapeutic products, based on responsive nanomaterials are under development and already approved for human use in some countries.

Nanomaterials is a field that takes a materials science-based approach to nanotechnology. It studies materials with morphological features on the nanoscale, and especially those that have special properties stemming from their nanoscale dimensions. Nanoscale is usually defined as smaller than a one tenth of a micrometer in at least one dimension, though this term is sometimes also used for materials smaller than one micrometer.

The fullerenes are a class of allotropes of carbon which conceptually are graphene sheets rolled into tubes or spheres. These include the carbon nanotubes (or silicon nanotubes) which are of interest both because of their mechanical strength and also because of their electrical properties. A common method used to produce fullerenes is to send a large current between two nearby graphite electrodes in an inert atmosphere. The resulting carbon plasma arc between the electrodes cools into sooty residue from which many fullerenes can be isolated.

Nanoparticles or nanocrystals made of metals, semiconductors, or oxides are of particular interest for their mechanical, electrical, magnetic, optical, chemical and other properties. Nanoparticles have been used as quantum dots and as chemical catalysts. Nanoparticles exhibit a number of special properties relative to bulk material. Sintering is possible at lower temperatures and over shorter durations than for larger particles. The surface effects of nanoparticles also reduces the incipient melting temperature.

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Biofuel as an alternative to the conventional energy sources

Biofuel is a type of fuel whose energy is derived from biological carbon fixation. Biofuels include fuels derived from biomass conversion, as well as solid biomass, liquid fuels and various biogases. Biofuels are gaining increased public and scientific attention, driven by factors such as oil price hikes, the need for increased energy security, concern over greenhouse gas emissions from fossil fuels, and support from government subsidies.' First-generation' or conventional biofuels are biofuels made from sugar, starch, and vegetable oil. Bioethanol is an alcohol made by fermentation, mostly from carbohydrates produced in sugar or starch crops such as corn or sugarcane. Ethanol can be used as a fuel for vehicles in its pure form, but it is usually used as a gasoline additive to increase octane and improve vehicle emissions. Biodiesel is made from vegetable oils and animal fats. Biodiesel can be used as a fuel for vehicles in its pure form, but it is usually used as a diesel additive to reduce levels of particulates, carbon monoxide, and hydrocarbons from diesel-powered vehicles. Biodiesel is produced from oils or fats using transesterification and is the most common biofuel in Europe. Biodiesel can be used in any diesel engine when mixed with mineral diesel.In 2010 worldwide biofuel production reached 105 billion liters , up 17% from 2009, and biofuels provided 2.7% of the world's fuels for road transport, a contribution largely made up of ethanol and biodiesel.The world's largest biodiesel producer is the European Union, accounting for 53% of all biodiesel production in 2010. Green diesel, also known as renewable diesel, is a form of diesel fuel which is derived from renewable feedstock rather than the fossil feedstock used in most diesel fuels. Green diesel feedstock can be sourced from a variety of oils including canola, algae, jatropha and salicornia in addition to tallow.

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Vegetable oil

Straight unmodified edible vegetable oil is generally not used as fuel, but lower quality oil can and has been used for this purpose. Used vegetable oil is increasingly being processed into biodiesel, or (more rarely) cleaned of water and particulates and used as a fuel. It is mostly used Great Britain as an alternative to petril

Biogas

Biogas is methane produced by the process of anaerobic digestion of organic material by anaerobes.It can be produced either from biodegradable waste materials or by the use of energy crops fed into anaerobic digesters to supplement gas yields. Biogas can be recovered from mechanical biological treatment waste processing systems.Landfill gas is a less clean form of biogas which is produced in landfills through naturally occurring anaerobic digestion.

First generation biofuels

Biologically produced alcohols, most commonly ethanol, and less commonly propanol and butanol, are produced by the action of microorganisms and enzymes through the fermentation of sugars or starches (easiest), or cellulose (which is more difficult). Ethanol fuel is the most common biofuel worldwide, particularly in Brazil. The ethanol production methods used are enzyme digestion (to release sugars from stored starches), fermentation of the sugars, distillation and drying. Ethanol can be used in petrol engines as a replacement for gasoline; it can be mixed with gasoline to any percentage. Most existing car petrol engines can run on blends of up to 15% bioethanol with petroleum/gasoline.

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New Kinds of steel for thermonuclear reactors

Scientists of Carlos III University of Madrid, Oxford University and the University of Michigan have joined efforts to develop new materials for thermonuclear fusion reactors. Their research focuses on characterization of oxide dispersion-strengthened, reduced-activation steel for the reactor structure.

Thermonuclear fusion promises to be a possible solution to the current energy crisis. It is produced when two atomic nuclei of light elements combine to produce heavier elements, which give off a huge quantity of energy. So that this reaction can occur, it is necessary to supply an enormous amount of energy, so that temperatures of many millions of degrees can be reached, allowing the nuclei to come close enough to overcome their natural repulsion and become condensed in a plasma state. This plasma, which reaches temperatures near that of the stars, around 100 million degrees, does not touch the walls of the reactors because they would melt. In order to confine the plasma, it is confined within the reactor by the magnetic fields. Even so the walls must resist some very high temperatures as well as the effects of the irradiation from the neutrons from the reaction, for which. It is nessenary to produce new materials that can withstand these extreme conditions.

The ITER project (under construction) and its successor, DEMO (scheduled for 2035) propose development of fusion reactors that are economically viable. This work depends on, among other things, the development of these new structural materials capable of withstanding damage by irradiation and elevated temperatures resulting from the fusion reaction. The scientific community has begun to develop new reduced - activation material for use in these reactors, but it is still not known if some of them will be viable under such hostile conditions. Along these lines, one of the most important candidates is oxide dispersion-strengthened, reduced-activation ferrite steel, called ODS steels.

The mechanic behavior of the ODS steels depends enormously on their microstructure, which until now has not been rigorously controlled. Until recently, studies on the microstructure of these steels have been on the micrometric scale. However, the nanometric scale is more relevant in understanding the phenomena that occur under irradiation. The knowledge in nuclear structural materials and in advanced techniques of nanoanalysis to characterize diverse new generation ODS steels on the nanonmetric scale, are used inowadeys. The additions of nanometric particles to these steels (between 1 and 50 nm), which help to improve the mechanical properties and increase their resistance.

The characterization of these materials is carried out using nanometric scale techniques. For example, with a transmission electron microscope, particles can be seen which are added to the material, even the smallest one of a nanometer (one millionth of millimeter). Because of this the following can be studied: if the distribution of the particles is optimum, its chemical composition, or if by changing it, better material is obtained or if interaction of these particles with the defects produced in the material is improved. From there the scientists extract the information that allows us to explain why material behaves in one way or another, because the fact that it has bad mechanical properties could be related to the particles not being well-distributed.

This research is focused on the study of oxide nanoparticles which are present in these steels, and the damage caused by radiation of these materials. The analyses carried out up to now show, for example, that the particles have a core-shell type structure consistent in an yttrium(Y) -rich nucleus surrounded by a chrome (Cr)-enriched area.

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The prospects of using modern renewed kinds of energy

The system crisis threatens the center of world deliveries of oil, therefore modern renewed kinds of energy enter the present-day life. The solar battery energy may be regarded as one of them.

A successful solar system requires a few components. First the system will need solar panels also known as photovoltaic cell panels. These panels collect the energy emitted from the sun's rays- these energy particles are called photons. The panels collect the photons and through a complicated process involving the transfer of ions the energy is created. The energy is then sent via wires to either a battery bank or to the inverter which converts the energy from DC to the AC form that our household electronics use. Solar batteries are an important part of a solar system. For homes that are completely off the grid the batteries are crucial to the efficiency of the system. A solar battery bank is what will keep the house supplied with energy during nighttime hours and on cloudy days. The battery bank can be used in case of power outages during the times the home is pulling from the grid. Optionally it can also be used to supplement even more of the home's energy, prolonging the use of the solar power. A battery bank will only help the homeowner to save more on utility costs and can quickly pay for itself the first couple of years. Solar battery banks use lead acid batteries to store the energy. These batteries can be dangerous and some have a risk of spilling or leakage. Due to this reason some homeowners try not to use them because of safety concerns, but properly built banks can be quite safe so homeowners. Outside of home solar systems the term solar battery can be heard in reference to small devices powered by the sun. These devices don't use the lead acid batteries used in home systems, they use rechargeable traditional alkaline batteries. They can work in a couple of ways.

First of all small solar powered devices can work without the use of a battery at all; instead the energy is converted and directly used- like commonly seen in a calculator. Another way is through the use of a solar battery charger. The solar cells collect the energy and recharge internal batteries. These internal batteries cannot typically be removed such as in solar garden lighting. Finally, a solar battery charger can be an external, entirely separate device. These chargers may be used to charge rechargeable alkaline batteries, like a set of double A batteries for a camera. Some of these external chargers work for internal batteries like cell phones, mp3 players and laptops. Solar technology has come a long way in recent decades. Reducing our planet's reliance on fossil fuels is necessary for all life on Earth. Solar advances are still continuing to be made and renewable energy concepts are now gaining speed in our industries.