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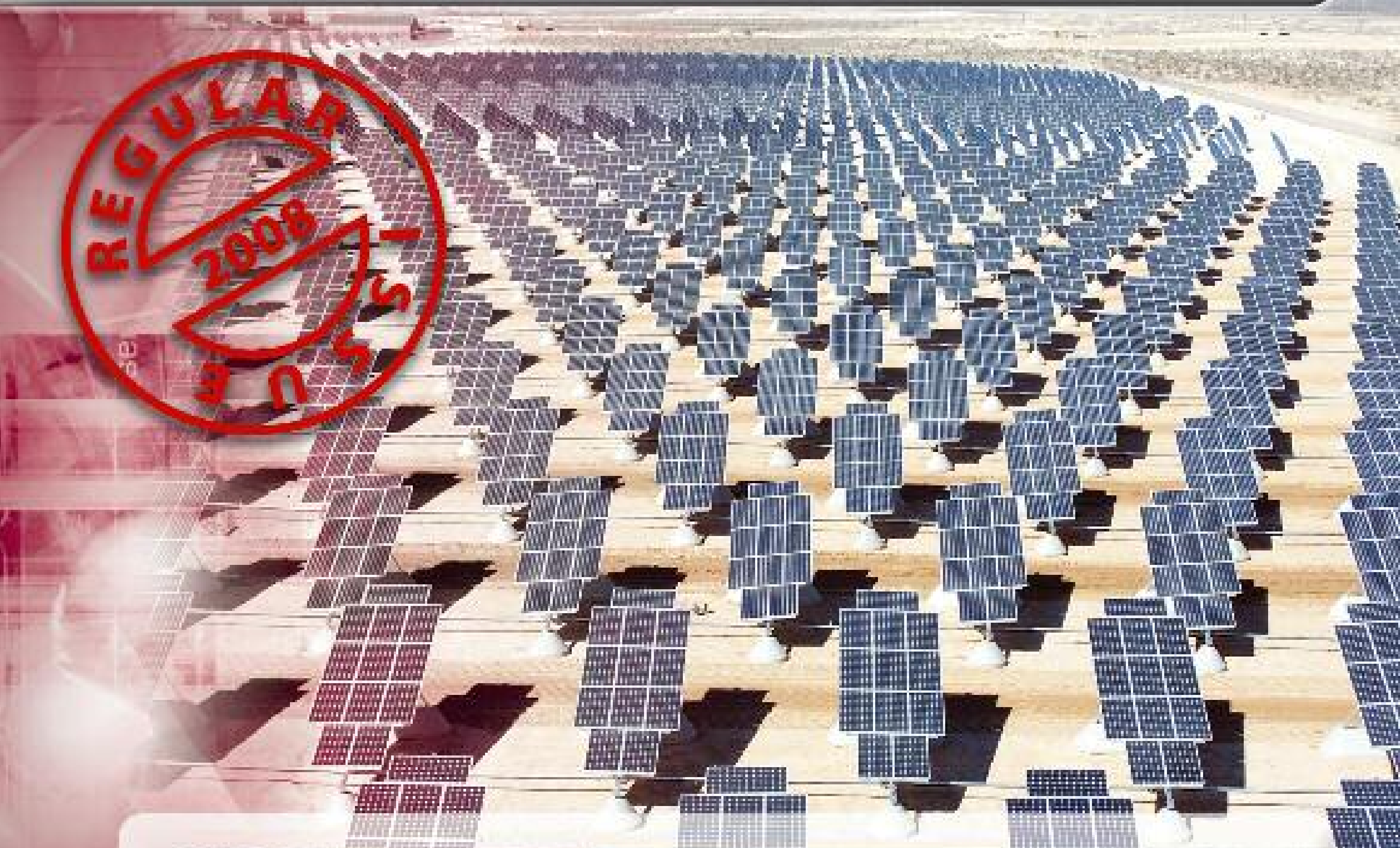

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Cover story

Silicon is the main material on which photovoltaics development depends. It belongs to n-type donor semiconductors or p-type accpetor ones, depending on its admixtures. The pentavalent donor elements atoms introduced into silicon (but also into germanium), e.g., P or As, or with a bigger number of palence electrons, bond with Si (or Ge) atoms with four electrons only, introducing the remaining excess electrons to the semiconductor conduction band, demonstrating the elektron conduction. The conduction electrons move under the influence of the applied electric field causing charge transfer, and releasing of electrons is favoured by temperature increase, Chile conductivity gets bigger along with the doping agents atoms concentration increase. Atoms of the trivalent acceptor elements, e.g., B or Al, or with a smaller number of valence electrons introduce the unfilled energy state called holes to the valence band, so the electrons from this band are excited to the acceptor state with energy higher than the upper palence band limit. The hole conduction grows also with the increase of temperature and concentration of the dope atoms. The photovoltaic effect occurring in silicon and in some other semiconductors consists in generating a pair of current charge carriers electron-hole in the semiconductor by the solar radiation photons with the energy exceeding the gap of energy levels of this semiconductor. The electric charge developed this way may undergo recombination due to which solar energy is converted into heat energy which should be counteracted. The value of the photovoltaic current depends, among others, on the power of the solar radiation fetching at Earth, area of the illuminated surface, and also on the type of material in which the radiation energy absorption takes place. The intensive research on mastering the photovoltaic cells technology have brought their efficiency to more than 20%. Photons of the electromagnetic radiation falling onto the semiconductor surface can be absorbed by it, participating in the photovoltaic effect when the remaining two phenomena of reflecting the photons from the surface or their transition through the material are useless from the photovoltaics point of view. If the photon energy is significantly higher than the semiconductor energy gap width then energy of this surplus is converted into heat energy and is dissipated. Because of the energy gap specific for silicon about 44% of the solar radiation energy fetched up can be used. Materials with a bigger energy gap generate a higher photoelectrical voltage; whereas, materials with a smaller energy gap use bigger part of the solar spectrum and provide a higher short-circuit current. Silicon is characteristic of a skew energy gap; therefore, photons participate in electron transition from the valence band to the conduction band and one or more phonons is absorbed or emitted. In semiconductors with such gap the life of carriers is longer than in case of those which have the straight energy gap.

In USA photovoltaic arrays have been used to day mainly on a small scale, for the light roadside signs or as rooftop panels to provide energy for homes or commercial buildings. An example are the solar panels on the buildings in the research giant Google campus, which are expected to provide around 1,600 kW/h of the electricity. The bird's-eye view of this campus is shown in the first small photo on this Issue cover.

However, the photovoltaic power stations develop very intensively in the last years – also in USA. The largest solar power plant in North America was opened in December 2007, shown in the big photo on this Issue cover. This power station provides electricity to Nellis Air Force Base in the Nevada desert in USA. Nellis, which is outside Las Vegas, is devoting ca. 56 ha to a massive photovoltaic array with panels of silicon wafers that rotate to follow the sun across the sky and generate electricity. The plant is capable totally of producing 15 MW of the electricity, enough to provide 30% of the electric needs on the Nellis Air Force Base, where 12,000 people work and 7,215 people live. The Air Force expects to save $1 million a year in lower electric bills and to use the plant to demonstrate it is boldly advancing the use of renewable energy technology.