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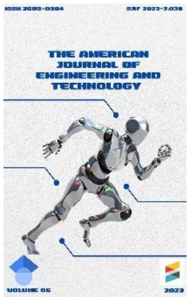


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Research Article

# SEMICONDUCTORS ARE THE BASIS OF DEVELOPMENT

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## ABSTRACT

In this article, the important importance of semiconductors in the development of time and technology, the prospects for the development of their fields of use is studied and information is presented. The use of semiconductor devices and lasers is analyzed. It is also noted that the types of lasers have a positive effect on the development of the field.

## KEYWORDS

Semiconductor, semiconductor devices, laser, semiconductor lasers, solar panels, diodes, energy.

## INTRODUCTION

In modern radio-electronic devices, devices made with consideration of semiconductor materials and their properties are important because they have economic, energetic and compact convenience qualities. The number and scope of scientific researches conducted in this field shows the relevance of the field's perfection and use of semiconductor materials. The emergence of semiconductor devices made a revolutionary turn in radio engineering. Their simplicity, energy efficiency and small size (compactness) made it possible to prepare them as micromodules by continuous printing method. Micromodules are thin sheets on which diodes, triodes, resistors and other elements of the radio circuit are stamped. It is possible to make radio devices with predetermined parameters by building different combinations of micromodules. Currently, there are no electronic devices that do not use semiconductor diodes, triodes, resistors. Examples of semiconductor thermistor devices include temperature detectors, elemental particle recorders, photoresistor-light energy recorders, and many other devices. All spaceships are equipped with semiconductor solar cells that convert solar energy into electrical energy, while medicine is equipped with sensors (recorders) that penetrate the sensitive organs of a person and provide information on their activity. Although these facts alone show the wide field of use of semiconductor devices, their prospects for use are still very wide. Diodes performing special tasks are used, in particular, to stabilize constant voltage, record optical radiation, generate signals in electrical circuits, and perform other tasks. Fused diodes are mainly made of silicon and are used to rectify currents with a frequency of up to 5 kHz. Diodes made of silicon, made by the diffusion method, can be used at high frequencies (up to 100 kHz). Silicon diodes (based on Schottky bars) prepared by the epitaxy method can be used at frequencies up to 500 kHz. Rectifier diodes based on gallium arsenide have the best frequency characteristics and can operate up to several megahertz.

Today, the word laser is not unfamiliar to anyone. Among other materials, semi-conducting materials are also used in the preparation of lasers used in almost all fields. Laser (in English laser- Light Amplification by Stimulated Emission of Radiation — taken from the initial letters of words that mean light amplification with the help of forced radiation), optical quantum generator — a device that generates radiation in the ultraviolet, infrared, and visible range; one of the key devices in quantum electronics. The first laser was created in ruby in 1960 by the American scientist T. Mayman. Its work is based on forced radiation of atoms and molecules. A laser converts various energy (electrical, light, chemical, thermal, etc.) into coherent electromagnetic light energy in the optical range. It consists of 3 elements - energy source, active medium (substance), reverse coupling (if the laser serves to amplify the coherent beam, the reverse coupling is not necessary). The laser differs from other light sources by its coherence, monochromaticity, directed at a very small angle, high spectral density of light power, and very high vibration frequency. According to the active medium, lasers are divided into the following groups: 1) solid and liquid lasers; 2) gas lasers; 3) semiconductor laser. In addition to these, excimer, chemical, etc. There are also laser types. Reverse coupling in lasers is performed using an optical resonator (two mirrors). An active substance is placed between the mirrors. The light wave returns from the mirrors and again passes through the active substance, causing forced transitions in it. One of the mirrors is partially transparent, which serves to allow the intensified light to escape after an infinite number of passes.

Atomic structure is important in the principle of operation of lasers. The energy states (orbits) of the atoms that make up the substances are different laser. An atom with a particle in a lower orbit is stable, an atom with a particle in a higher orbit is unstable. A particle does not stay long in a higher orbit. After a certain time, the particle falls into a lower orbit and the atom emits light. It can "push" it down from its higher energy states (orbits), that is, if it does not fall into a more stable energetic state. This is called forced radiation in science. Just as a single rock rolled down a mountain rolls several rocks down, so when one particle of matter is pushed, the particles in all the orbits are excited. The light emitted by the atom and the absorbed light are added, and two equals four, four equals eight, and so on. Turns into laser light. These beams are amplified by a quantum generator (similar to an electric signal amplifier) and converted into a highly directed beam (energy). Due to the energy source (direct current, high or very high frequency current, optical or laser light, electron beam), the electrons in the active substance move to higher (excited) levels, and the inversion state occurs (the number of electrons in the upper level N2 is greater than in the lower level N, ) occurs. When they are

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exposed to an energy source (for example, a light beam), the active substance is activated. In this case, the energy given to the electrons increases several thousand times, and then it takes the form of a laser light. In addition, the amplification coefficient Kk of the laser light in the device should be much greater than the coefficient of energy losses Ky occurring in it (KkJ.). Laser light generation can be achieved when these conditions are met. The laser has 2 different modes of operation. If a continuous energy source is used in it, it is possible to create a continuous thin beam. If the source provides pulsed energy, the laser emits pulses of light.

A solid-state laser (ie, a ruby laser) uses a crimson crystal glass rod made of aluminum oxide (A12O3) with up to 0.05% chromium (Sg3+) ions (activator). In this case, the ruby is in the form of a cylinder, and mirrors forming an optical resonator are placed at both ends of the ruby axis. The light emitted from the pulsed lamp creates vibrations. When the light from the lamp falls on the ruby, the chromium ions go into a "wake up" activated state, absorbing the green and yellow parts of the radiation spectrum emitted by the lamp. As a result, an active environment ready for radiation is formed, and light quanta multiplying in the form of a beam directed perpendicularly to the mirror along the axis of the ruby appear. The power of light generated in ruby LEDs reaches 20 kW. Their f.i.k. 0.1% to 10%. The generation of laser light depends on the activator transitioning between energy levels. The wavelength of the infrared light produced in it is >.=0.69 μm. A glass (CaWO4) rod with neodymium (Nd3+) ions is used as an active substance in neodymium L. from solid L.s. This laser emits infrared light of λ=1.06 μm.

"Rhodamine-6J", pyranin, trypaflavin and others are used instead of the active substance in the laser made of liquid bodies. Using alcohol, acetone, toluene, etc. as a paint solvent, the active substance is placed in a glass cuvette. A schematic structure of a dye laser excited by a nitrogen laser is shown. In gas lasers [the first gas laser (He-Ne) was created by the American scientist A. Javan], the active medium is a gas (or gas mixture). For example, helium-neon (Ne-Ie) active medium consists of a mixture of helium and neon gases. The gas mixture is activated by an electric discharge. In such lasers, generation occurs when Ne passes between levels. It emits light of 3 wavelengths: λ1=0.63 μm (red light), λ2=1.15 μm and λ3=3.39 μm (infrared rays). A gas laser (CO2+N2) emits a beam with a length of λ =10.6 μm. Ion and chemical lasers are also gas lasers. In ion lasers, the active medium is ionized atoms, and in chemical lasers, there are atoms that have become "awakened" in chemical reactions (an argon laser operating at ion levels emits blue light). At the Department of Quantum Radiophysics of the National University of Uzbekistan (Uzbekistan National University), a compact light SO2 laser operating on transistor autogenerators of the ultra-high frequency field has been created.

In semiconductors such as GaAs lasers, the active medium is semiconductors. In such lasers, the medium is activated by optical and electron flow. In this type of lasers, the laser transitions are between the conduction-valence bands and the donor-acceptor levels. These are called laser diodes. A semiconductor diode consists of a crystal plate with a thickness of 0.1 mm and a surface area of several mm2. When a direct current is passed through these diodes, the electrons move to higher zones or levels, and an inversion state occurs. When electrons move to the lower zone (or levels), laser light generation is observed due to the energy released as a result of electron-hole recombination. The wavelength of infrared light coming from GaAs L. is 0.84 μm. Among the semiconductor lasers, there are lasers with the active substance CdS (blue light), CdTe (red, dark red light - red), CaSb (red; infrared light). Semiconductor lasers are simple in structure, small in size, and long-lasting. Beam power in lasers is in the order of solid-state lasers, liquid-state lasers, gas lasers, and semiconductor lasers, F.I.K. and decreases in the order of semiconductor laser, liquid laser, gas laser and solid state laser. Beam narrowness (pointing at a narrow angle) is best for gas lasers and worst for semiconductor lasers. The dimensions and weight of the device are the largest in solid-state lasers, gas and liquid, average in solid-state lasers, and smallest in semiconductor lasers. Different lasers emit light from ultraviolet to visible to infrared.

Laser is widely used in various fields. Solid-state lasers are used in laser spectroscopy, laser technology (solid, solid-state cutting, welding, drilling), nonlinear optics, and gas lasers in frequency and length standardization, optical systems testing, markshader work, laser chemistry, medicine; Semiconductor lasers are compact, lightweight, and are widely used in optical communication systems, audio and video systems, night vision devices, optical data processing, and projection laser television. Chemical lasers are used in atmospheric control systems. lasers are used in forensics, terrestrial and underwater optical communication, fiber optic telephone communication systems, laser CD making, surgical operations, ophthalmology, controlled fusion, etc. is used in Lasers range in size from microscopic diode lasers (top) to football-field-sized neodymium glass lasers (bottom) used for inertial confinement fusion, nuclear weapons research, and other high-energy-density physics experiments.

When lasers were invented in the 1960s, they were called "problem-seeking solutions." Since then, they have become ubiquitous, useful in thousands of different applications in all sectors of modern society, including consumer electronics, information technology, science, medicine, industry, law enforcement, entertainment, and the military. . Fiber optic communication using lasers is the main technology of modern communication and provides services such as the Internet. The first widespread use of lasers was a supermarket barcode scanner introduced in 1974. The laser disc player, introduced in 1978, was the first successful consumer product to incorporate a laser, but the compact disc player was the first laser-equipped device to become widely available. , starting in 1982, laser printers appeared in a short period of time.

**Use in other areas:**

Communications: In addition to fiber optic communications, lasers are used for free space optical communications, including laser communications in space.

Industry: cutting, including conversion of thin materials, welding, heat treatment of materials, marking of parts (engraving and gluing), additive manufacturing or 3D printing processes such as selective laser sintering and selective laser melting, non-contact parts measuring and 3D scanning and laser cleaning.

Military: targeting, guided munitions, missile defense, electro-optical countermeasures (EOCM), lidar, blind troops, firearms sighting. See below

Law Enforcement: LIDAR Traffic Rules. Lasers are used for latent fingerprint detection in forensic identification.

Research: spectroscopy, laser ablation, laser annealing, laser scattering, laser interferometry, lidar,

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laser absorption microdissection, fluorescence microscopy, metrology, laser cooling

Commercial products: laser printers, barcode scanners, thermometers, laser pointers, holograms, bubbles

Entertainment: optical discs, laser light displays, laser turntables

In 2004, excluding diode lasers, approximately 131,000 lasers were sold at a value of US$2.19 billion. In the same year, approximately 733 million diode lasers were sold, valued at US$3.20 billion.

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