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Extended Abstract

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Surface electromagnetic waves: Past, present, future

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From the beginning of the 20th century, researchers have been interested in surface electromagnetic waves guided by planar interfaces of dissimilar mediums. Much initial research on surface-plasmon waves and surface-plasmon-polariton waves stemmed from theoretical curiosity, but the development of new experimental techniques propelled commercial exploitation for optical sensors of chemical and biological species. Additional surface waves called Dyakonov waves, Tamm waves, and Dyakonov–Tamm waves have emerged during the last 25 years. Experimental observation of Dyakonov waves was reported only in 2009, but the rapid development of experimental apparatus during the 1990s suggests that theoretical predictions will soon be evaluated experimentally, leading to further development of optical detection systems and optical circuitry. Surface electromagnetic waves (SEV) have been known for 117 years. Currently, they are widely used in optical and investigated at THz frequencies in the area which form the basis of the current status and future development of nanotechnologies (plasmonics). The history of the research of electromagnetic waves that are different in nature from spatial Maxwell-Hertz electromagnetic waves and emerging on the boundary of two media with different dielectric properties, developed from universal acceptance in the early 20th century the concept of SEV Sommerfeld-Zenneck, until the categorical denial by middle-century, the revival of interest in 60-years and experimental confirmation by the beginning of the 21st century. In Russia, the theory of SEV developed intensively, and experimental proof of the existence of SEV was given: waves of ultrahigh frequencies detected and investigated in the laboratory in the magnetized semiconductors, on salt water, gas plasma and metals; were observed in vivo. SEV exist at frequencies up to optical.

To date, they are best explored in the ultra high frequency range and optics (plasmon- polaritons). Extended field studies in the field of high, low and ultralow frequencies holds exciting prospects: (OTH) radar, new channels of global telecommunications, monitoring the surface of oceans, weather management, wireless transfer of energy flows on the surface of earth and the bottom edge of the ionosphere from continent to continent. SEV have dramatic past, pragmatic present and a great future. Based on the single-fluid plasma model, a theoretical investigation of surface electromagnetic waves in a warm quantum magnetized inhomogeneous plasma is presented. The surface electromagnetic waves are assumed to propagate on the plane between a vacuum and a warm quantum magnetized plasma. The quantum magnetohydrodynamic model includes quantum diffraction effect (Bohm potential), and quantum statistical pressure is used to derive the new dispersion relation of surface electromagnetic waves. And the general dispersion relation is analyzed in some special cases of interest. It is shown that surface plasma oscillations can be propagated due to quantum effects, and the propagation velocity is enhanced. Furthermore, the external magnetic field has a significant effect on surface wave's dispersion equation. Our work should be of a useful tool for investigating the physical characteristic of surface waves and physical properties of the bounded quantum plasmas. Radio waves are widely used in the fields of communication and sensing, and technologies for sending wireless power are currently being put to practical use. The barriers that have so far limited these technologies are about to disappear completely. In the present study, we examine waveguides, which are a key component of the next-generation wireless technologies. A waveguide is a metal pipe through which radio waves transfer. Although a waveguide is a very heavy component, due to technological innovations, waveguides will undergo drastic modifications in the near future. This chapter introduces trends in innovative waveguide technologies and the latest wireless systems, including communication and power transfer system, that use waveguides. Electromagnetic waves are waves formed by changing electric and magnetic fields in space. Electromagnetic waves refer to waves with a wavelength of 100 μm or more (3 THz or less). They are described as microwaves or millimeter waves, depending on the wavelength. The existence of electromagnetic waves was predicted by J. C. Maxwell in 1864. J. C. Maxwell proved that the speed at which electromagnetic waves propagate is equal to the speed of light and revealed the fundamental principle that light is propagated in the form of electromagnetic waves. Moreover, to date, electromagnetic waves are used for various purposes ranging from communication and sensing to microwave ovens. Electromagnetic waves are colloquially described as "fluttering in space," and it can be said that life is established by these waves. In recent years, attention has been paid to a technology for wireless power transfer. This technology converts electric power that was previously sent by wire into electromagnetic waves to transmit electricity in space.

Bottom Note: *This work is partly presented at 2nd International Conference on Physics August 28-30, 2017, Brussels, Belgium*