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STEALTH TECHNOLOGIES
СТЕЛС-ТЕХНОЛОГИЯ

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Аннотация:

В данной статье мы рассмотрим технологию стелс, ознакомимся с историей создания и внедрения в авиацию. Мы изучим метод работы стелс с помощью принципа работы радаров и нанотехнологий, а также проанализируем перспективы стелс в наше время.

Introduction

Stealth technologies are more like special magic than mere modification, because they make things simply invisible and invincible. These technologies are connected with any modern fighter, bomber, warship or submarine. The world's leading militaries spend billions trying to develop or "acquire" stealth technologies. But is the word "stealth" properly understood by public? In this article, we will discuss the creation of these technologies, explain the physical and engineering principles behind them, and try to present a clear understanding of how this complex technology works.

The story of creation

In the 1960s, Soviet physicist Peter Ufimtsev first developed a model to predict how electromagnetic waves (such as radar waves) would scatter when they came into contact with 2D and 3D surfaces. Although his work was published in the USSR, it found no practical application. This continued until defense contractor Lockheed came across Ufimtsev’s study and translated it in English; Ufimtsev's work thus served as a background for modern stealth technology and confirmed that a special shape could reduce the radar signature of an airplane. The main surfaces of the airplane - nose, fuselage, wings, ailerons, flaps, cockpit lantern, etc. - could be analyzed and then expressed in the form of the so-called "radar section".

Development issues

Later on, the technology encountered a certain problem: aircraft with large flat surfaces, such as the fuselage of the B-52 bomber, or vertical stabilizers, such as the F-111 tactical bomber, reflected large amounts of radar energy. External stores such as bombs, missiles, and fuel tanks also reflected energy. Attention to detail was required: air intakes could actually focus radar energy, creating a sharper return, while even rivets, gaps, or the slightest protrusions could reflect energy.

Radars

To understand stealth technology, we need to know the basic principle of radar. Radar emits electromagnetic waves that are reflected from the obstacle and then returned. This signal is processed to determine the exact position, size and direction of the target. This further spoils the element of surprise of the attacking party. Like many other inventions, the exact date of radar's creation and the name of its inventor are difficult to determine. In the first half of the 20th century, scientists from different countries advanced in development in parallel, sometimes arriving at the same solutions almost simultaneously. The creation of complex devices such as radar is always the result of the collective work of many individuals and groups. However, historians agree that the approach of World War II was a kind of gas pedal for many of the key technologies of the 20th century, including radar. This was observed during World War II when British radar prevented surprise attacks by the Luftwaffe by detecting incoming bombers minutes in advance and directing fighter planes to intercept them. Radar also played a huge role in the Cold War as each side developed new radars.

Stealth technology combines many tools and techniques to make an object "invisible" to adversaries on the battlefield. In many military applications, stealth technology is critical to the survival of the system. This is the "invincibility" of these technologies. In this context, the measure of stealth is radar efficiency (EPR), which must be minimized. Since metals are key structural materials of military vehicles, weapons, and equipment, they can be targeted and detected by radio detection and ranging (RADAR) systems. Radio absorbing materials (RAMs), critical components of passive countermeasures in modern military tactics, are used to absorb electromagnetic waves. At the same time, mainly due to their high electrical conductivity, RAMs - in combination with the clever geometry of the objects in which they are incorporated - can provide programmable reflection, multiple internal reflection and scattering in the direction of shielding against electromagnetic interference (EMI). Today, recent advances in nanotechnology have turned stealth technology into an even more powerful tool.

Nanotechnology

Nanotechnology as a science began to take shape at the end of the twentieth century. At the end of the twentieth century, the science of nanotechnology began to take shape. Then at the beginning of the twenty-first century it began to develop rapidly due to the funding of development programs in the United States, Japan and China. Today, nanotechnology holds great promise in various fields such as information technology, electronics, materials production, environmental protection and energy, biology and medicine, agriculture, aviation and the space industry. Nanotechnology, a branch of science that investigates materials and phenomena at scales smaller than 100 nm, is a recognized interdisciplinary field of science with new implications for the real world. And among many nanomaterials, carbon nanotubes (CNTs) have emerged as one of the most promising active components of RAM and electromagnetic interference shielding materials. Russian scientists first discovered nanotubes during the disproportionation of carbon monoxide on reduced

iron particles. This work was published in 1952, but was not widely disseminated. Nanotubes are cylindrical structures consisting of one or more layers of graphite coiled together. They can be multilayer, with spacing between layers corresponding to the distance between graphite layers, and single-layer, having diameters ranging from 0.7 to 2.0 nm and lengths up to hundreds of microns. Nanotubes are highly strong and elastic, able to withstand high stresses without rupturing.

Currently, more than 100 companies around the world are engaged in the production of nanotubes and nanofibers. These are mostly companies established on the basis of scientific laboratories. The main method of producing carbon nanotubes is continuous synthesis from high-purity gaseous hydrocarbons using efficient catalysts.

Technology today

Powertrain control module (PCM) with Stealth infrared technology have recently been used for infrared stealth and thermal camouflage for military or scientific applications. A flexible and foldable composite film has also been developed using a hybrid polyimide-phosphorus aerogel impregnated with polyethylene glycol (PEG), which has demonstrated excellent thermal management capability to mitigate temperature fluctuations.

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