ejpmr, 2025, 12(6), 718-724

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

SJIF Impact Factor 7.065

Review Article

ISSN (O): 2394-3211

ISSN (P): 3051-2573

A SUBMARINE IS SUBMERSIBLE NAVAL WARSHIP TO WORSHIP THE FOUNDATION TO CORONATION DURING WARFARE

[1*]Dr. Pruthviraj K. Chaudhary, [1]Shloka V. Chaudhari, [2]Sanjaykumar A. Chaudhary, [3]Dushyant P. Chaudhary, [4]Dr. Hitesh D. Karen and [5]Dr. Dhrubo Jyoti Sen

[1]Shri Sarvajanik Pharmacy College, Gujarat Technological University, Arvind Baug, Mehasana-384001, Gujarat, India.
[2]Shri J. M. Chaudhary Sarvajanik Vidyalay, Arvind Baug, Mehsana-384001, Gujarat, India.
[3]The University of Texas at Arlington, 701 S Nedderman Drive, Arlington, Texas-76019, USA.
[4]Tolani Institute of Pharmacy, Nursery Plot, Ward 2A, Opp. Hotel Midtown, Adipur, Kachchh, Gujarat.
[5]School of Pharmacy, Techno India University, Salt Lake City, Sector-V, EM: 4/1, Kolkata-700091, West Bengal, India.

***Corresponding Author: Dr. Pruthviraj K. Chaudhary**

Shri Sarvajanik Pharmacy College, Gujarat Technological University, Arvind Baug, Mehasana-384001, Gujarat, India.

Article Received on 21/04/2025 **Article Revised on 11/05/2025** **Article Accepted on 01/06/2025**

ABSTRACT

A submarine (often shortened to sub) is a watercraft capable of independent operation underwater. (It differs from a submersible, which has more limited underwater capability.) The term "submarine" is also sometimes used historically or informally to refer to remotely operated vehicles and robots, or to medium-sized or smaller vessels (such as the midget submarine and the wet sub). Submarines are referred to as boats rather than ships regardless of their size. Submarines are specialized underwater vessels used for various purposes, including naval warfare, scientific research, and exploration. Military submarines are designed for patrolling, attacking enemy ships, and conducting special operations, while smaller submarines are used by scientists to study marine life, underwater geology, and oceanographic conditions.

KEYWORDS: warship, naval, torpedo, missile, marine, underwater, submersible, warfare, buoyancy

OVERVIEW

A marine submarine, often shortened to submarine or sub, is a type of naval vessel designed to operate both on the surface and underwater. It is capable of submerging and navigating beneath the surface of the sea, and is typically equipped with weapons like torpedoes and missiles for warfare. It is a submersible device active in naval areas.

Figure-1: Submarine the naval warship.

Here's a more detailed explanation.

Features

- Underwater Navigation: Submarines are designed to travel and operate beneath the surface of the water, unlike surface ships.
- Military Application: Submarines are primarily used for naval warfare, patrolling oceans, and attacking enemy ships.
- Weaponry: They are typically armed with torpedoes, missiles, and other weaponry to engage other vessels.
- Size and Crew: Military submarines can be very large, carrying a crew of over 100 people.
- Diving and Surfacing: Submarines use ballast tanks that fill with water to submerge and release water to surface.
- Power Sources: They utilize various power sources like engines, batteries, and nuclear power.
- Navigation Systems: Sophisticated sonar and other technologies help them navigate and locate targets.

  In essence, a marine submarine is a submersible warship designed for underwater operations and combat. A submarine is a watercraft capable of independent operation underwater. They are used by navies for various purposes, including patrolling, attacking, and strategic deterrence. Submarines can dive and surface by manipulating their buoyancy, using ballast tanks and diving planes.

Definition: A submarine is a vessel designed to operate both on the surface and submerged underwater.

- Buoyancy Control: Submarines control their depth by adjusting the amount of water in their ballast tanks, which affects their overall density.
- Diving and Surfacing: They use diving planes (small wings) to control the angle of the dive and surface.
- Naval Warfare: Submarines are crucial in naval warfare, capable of launching torpedoes and missiles.
- Strategic Deterrence: Nuclear submarines, capable of remaining submerged for extended periods and launching long-range missiles, play a key role in strategic deterrence.
- Other Uses: Submarines are also used for scientific research and exploration.

  Types: Submarines come in various types, including nuclear-powered and conventionally powered, and serve different roles like attack submarines and ballistic missile submarines.
- Indian Navy: The Indian Navy operates a fleet of submarines, including both conventional and nuclear-powered vessels.

Engineering structure [Construction]:

- Superstructure (Casing): This is the outer layer of the submarine that does not resist water pressure and is designed for streamlining and protection.
- Pressure Hull: This is the core, watertight structure that withstands the external water pressure and protects the crew and machinery.
- Materials: Submarine pressure hulls are typically made of high-strength steel, aluminum alloys, titanium, or composites. Steel is the most common due to its strength, knowledge of working with it, and performance in the ocean.
- Submarines are primarily made of high-strength alloyed steel. For deeper diving capabilities, some submarines use titanium. Other materials used in submarine construction include aluminum, acrylic plastic, and glass, though steel remains the most common choice due to its availability, cost-effectiveness, and performance in the ocean.
  - Steel: High-strength steel alloys are favored for their balance of strength, durability, and resistance to corrosion, making them suitable for the pressure hull and other structural components.
  - Titanium: Used in some submarines for deeper diving, titanium offers a higher strength-to-weight ratio than steel, allowing for greater depths while keeping the submarine's weight manageable.
  - Other Materials: Aluminum is sometimes used for non-structural components, while acrylic plastic and glass are used in certain areas like viewports or observation modules.
- Shape: Submarine hulls are often shaped like tear drops to reduce drag and improve hydrodynamic efficiency.
- Construction: Pressure hulls are often constructed using ring-stiffened cylindrical and conical shells, terminated with domes at each end.

Types: Submarines can be designed with either a single hull (only one layer of steel between the crew and the ocean) or a double hull (an inner pressure hull encased by an outer, non-pressure-resistant hull).

- Pressure Resistance: The pressure hull must withstand considerable hydrostatic pressure, which increases with depth.
- Buoyancy: Submarines maintain their depth using buoyancy control, with tanks used to add or remove water to change their overall density.[1]

Cornelis Jacobszoon Drebbel (1572 – 7 November 1633) was a Dutch engineer and inventor. He was the builder of the first operational submarine in 1620 and an innovator who contributed to the development of measurement and control systems, optics and chemistry. **John Philip Holland** (1841-1914) is famous as the "father of the modern submarine," designing the first submarine accepted by the U.S. Navy. Philip Holland (1721-1789) was an English nonconformist minister. **Sir Philip Welsby Holland** (1917-2011) was a British Conservative politician. Additionally, there is a Philip Holland who is a director and cinematographer, and another who is a business transformation.

Figure-2: Innovator and father of submarine.

Military Applications

- Naval Warfare: Submarines are a crucial part of naval warfare, providing stealth and mobility for conducting anti-submarine warfare, intelligence gathering, and attacking surface ships.
- Sea Denial: They can be used to deny an enemy access to the sea, blockading ports, and protecting vital sea lanes.
- Special Operations: Submarines can transport commandos, reconnaissance teams, and agents to carry out covert missions.
- Scientific and Exploration Applications:
- Ocean Exploration: Submarines allow scientists to access and explore underwater environments that would otherwise be inaccessible, enabling studies of marine life, geology, and oceanographic conditions.
- Research and Discovery: They provide a platform for collecting samples, conducting experiments, and making discoveries in the deep sea.
- Commercial Applications: Some submarines are used for commercial purposes, such as underwater construction, salvage operations, and oil and gas exploration.

Biggest submarine in India: Arihant-class submarine

Class overview

Type: Nuclear-powered ballistic missile submarine

- Displacement: Arihant & Arighaat: 6,000 t (5,900 long tons; 6,600 short tons) surfaced Aridhaman & S4*: 7,000 t (6,900 long tons; 7,700 short tons)
- Length: Arihant & Arighaat: 111 m (364 ft); S-4: 130 m (430 ft)
- Beam: 11 m (36 ft)
- Submarines vary in size, with the largest being the Typhoon-class submarine, measuring 560 feet (170 meters) long and displacing 25,000 tons. Smaller submarines, like the Seawolf-class, are 353 feet (107.6 meters) long and displace 9,137 tons. Some submarines, like the Virginia-class, are 377 feet (114.91 m) long.

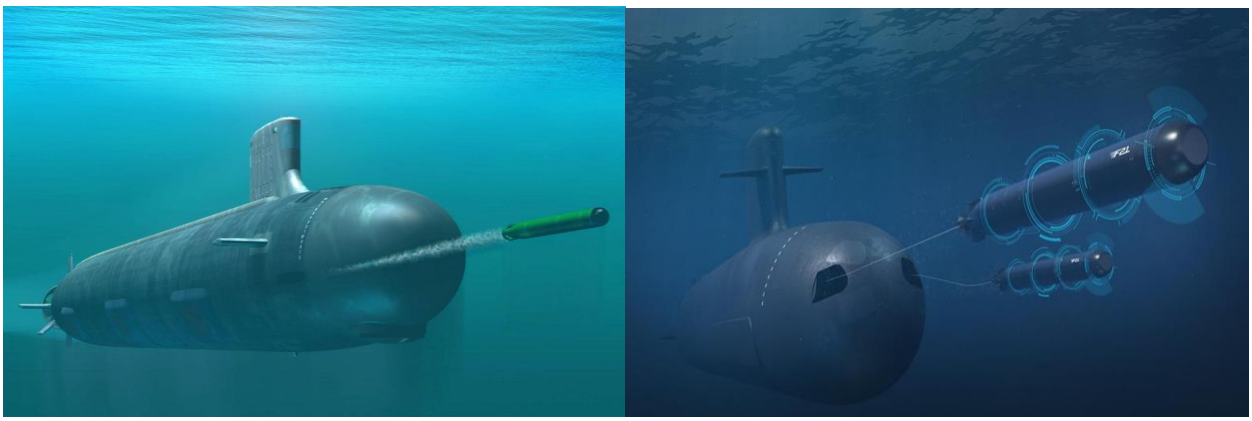

Figure-3: Torpedo ejection from submarine.

Here's a more detailed breakdown:

- Typhoon-class: The largest ever built, with a length of 560 feet (170.7 meters).
- Ohio-class: These ballistic missile submarines are a substantial size, with a submerged displacement of 18,750 tonnes (18,450 long tons).
- Virginia-class: A modern submarine class, with a length of 377 feet (114.91 meters).
- Seawolf-class: These submarines are 353 feet (107.6 meters) long.
- Vanguard-class: A UK nuclear-powered ballistic missile submarine, with a submerged displacement of 15,900 tons.
- Arihant-class: The first nuclear submarine designed and built by India, at 111 m (364 ft) long.
- Smaller tourist submarines: These can have a crush depth of 400-500 feet (120-150 m) and carry 50-100 passengers. India's submarine fleet consists of 16 conventional submarines and 3 nuclear-powered submarines. This includes 17 diesel-electric submarines and one nuclear-powered ballistic

missile submarine. One of the nuclear submarines is leased.

- Conventional Submarines: India operates 16 conventional submarines, including French-designed Scorpene-class, German HDW-class, and Russian Kilo-class submarines.
- Nuclear Submarines: The Indian Navy has 3 nuclear submarines, one of which is leased. These include the INS Arihant, which is a ballistic missile submarine.[2]

Submarines can dive to varying depths depending on their design and purpose. Military submarines typically operate at depths around 300-400 meters (1000-1300 feet), while some specialized research submersibles can reach the deepest parts of the ocean, exceeding 10,000 meters (36,000 feet).

Military Submarines: These submarines have a crush depth, which is the maximum depth they can safely operate at, typically around 300-400 meters (1000-1300 feet).

Specialized Submersibles: Submersibles like the Trieste and the DSV Limiting Factor have been designed to withstand extreme pressures and reach the deepest parts of the ocean, like the Mariana Trench, which is over 10,000 meters deep.

Factors Affecting Depth: A submarine's depth capability is influenced by its design, materials, and the intended purpose of the vessel. Military submarines prioritize stealth and operational depth, while specialized submersibles focus on scientific exploration and research.

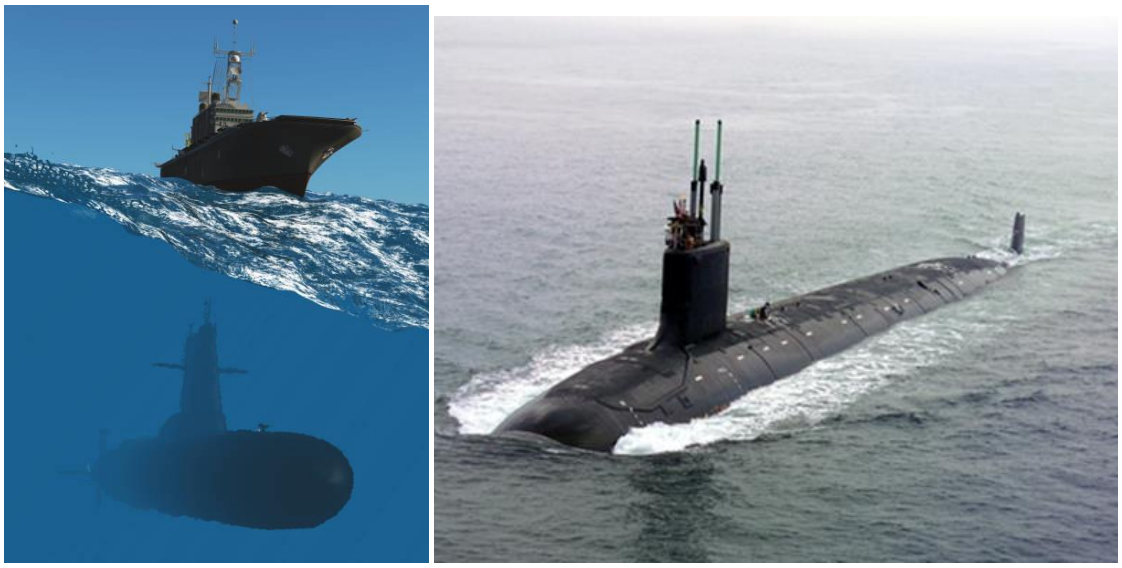

Figure-4: Foundation to Coronation: Warship to Worship.

Submarines have a complex internal structure designed to withstand immense pressure and house various crucial systems. Key components include the pressure hull, which protects the crew and equipment, and the sail (or fin), which houses communications and sensing devices. Internal compartments are organized for functions like control, weapons, crew quarters, and propulsion.

First Submarine to Use New Stealth Technology - Naval News.

Mechanical Construction

1. Pressure Hull: This is the primary structure of the submarine, a strong, cylindrical shell designed to withstand the crushing pressure of the deep ocean. It's typically made of high-strength steel and divided into compartments.

2. Sail/Fin: This structure, located on top of the hull, houses periscopes, antennas, and other sensors. It serves as an observation platform when the submarine is near the surface.

3. Internal Compartments: Submarines are divided into various compartments for specific functions:

Control Room: This is the command center where the submarine is navigated and controlled.

Missile/Torpedo Room: Stores and prepares weapons for launch.

Crew Quarters: Living spaces for the crew.

Engine Room: Houses the propulsion system and power generation equipment.

Reactor Compartment (Nuclear Subs): Houses the nuclear reactor that provides power.

4. Propulsion System: This system provides the submarine with the power to move through the water. It can include propellers, rudders, and for nuclear submarines, a nuclear reactor, steam turbines, and other machinery.

5. Ballast Tanks: These tanks are used to control buoyancy, allowing the submarine to dive, surface, and maintain depth.

Submarine interior hi-res stock photography.

6. Other Systems: Submarines also have systems for life support, navigation, communication, and other essential functions.

Submarines dive and surface by manipulating their buoyancy through ballast tanks and hydroplanes. By filling ballast tanks with water, they become denser and sink, while filling them with air makes them lighter and rise. Hydroplanes, or dive planes, adjust the submarine's angle in the water, allowing for controlled ascent or descent.[3]

Elaboration

1. Buoyancy Control: Submarines, like all ships, float because the buoyant force (upward force from displaced water) equals their weight.
2. Ballast Tanks: These are large tanks that can be filled with water or air.
3. Submerging: To dive, water is pumped into the ballast tanks, making the submarine heavier and denser than the water around it, causing it to sink.
4. Surfacing: To surface, air is pumped into the ballast tanks, forcing out the water and making the submarine lighter and less dense than the surrounding water, causing it to rise.
5. Hydroplanes (Dive Planes): These are movable wings, usually located at the front and back of the submarine. By adjusting their angle, they can control the submarine's dive angle, allowing it to change depth and steer while submerged.
6. Power and Propulsion: Submarines typically use a combination of diesel-electric engines and batteries for power. Nuclear submarines use nuclear reactors for propulsion.
7. Propellers: Drive the submarine forward or backward in the water.
8. Steering: Submarines steer using a tail rudder and hydroplanes. The tail rudder controls the submarine's heading (left or right), while hydroplanes control its pitch (up or down).
9. Trim Tanks: These are small tanks that can be filled with water to adjust the submarine's trim (balance). Water can be pumped between the bow and stern trim tanks to keep the submarine level.
10. Emergency Procedures: In emergencies, ballast tanks can be rapidly filled with high-pressure air to surface the submarine quickly.
11. Life Support: Submarines need to maintain breathable air, which is supplied from compressed air tanks, oxygen generators, or other means. They also have systems to remove carbon dioxide and other waste gases.[4]

Figure-5: Torpedo & Missile.

Torpedoes: Most large submarines consist of a cylindrical body with hemispherical (or conical) ends and a vertical structure, usually located amidships, which houses communications and sensing devices as well as periscopes. In modern submarines, this structure is called the "sail" in American usage and "fin" in European usage. All small modern submarines and submersibles, as well as the oldest ones, contain a single hull. However, for large submarines, the approaches have separated. All Soviet heavy submarines are built with a double hull structure, but American submarines usually are single-hulled. Submarines traditionally had two periscopes: a navigation or observation periscope and a targeting, or commanders, periscope. Navies originally mounted these periscopes in the conning tower, one forward of the other in the narrow hulls of diesel-electric submarines. A submarine hull has two main components: the superstructure (or casing) and the pressure hull. The pressure hull is the watertight, load-bearing structure that withstands the immense water pressure at depth. The superstructure is the outer, non-pressure-resistant part of the hull.[5]

A torpedo is a self-propelled, underwater weapon with an explosive warhead, designed to attack ships or submarines. It's a cigar-shaped projectile that is launched from a submarine, surface vessel, or even an aircraft. The term "torpedo" also refers to a genus of electric rays, or electric torpedoes, which are known for their ability to deliver an electric shock. A modern torpedo is an underwater ranged weapon launched above or below the water surface, self-propelled towards a target, with an explosive warhead designed to detonate either on contact with or in proximity to the target. Historically, such a device was called an automotive, automobile, locomotive, or fish torpedo; colloquially, a fish. The term torpedo originally applied to a variety of devices, most of which would today be called mines. From about 1900, torpedo has been used strictly to designate a self-propelled underwater explosive device.

- **Military Torpedoes:** These are the cylindrical, self-propelled underwater missiles designed to destroy ships and submarines. They are launched from various platforms and are propelled by a motor, typically electric or fuel-based, and equipped with a warhead that explodes upon impact or proximity.
- **Electric Rays (Torpedoes):** These are marine animals, specifically the genus Torpedo, that have the ability to generate electric shocks. They are slow-moving, bottom-dwelling fish that use their electric organs to stun prey or defend themselves.
- **Torpedo (Car):** In the automotive world, "torpedo" refers to a type of car body style, particularly those with a streamlined design, a detachable soft top, and a raised hood line.

A torpedo is a type of missile or bomb fired underwater. To torpedo is to attack with torpedoes. Torpedoes are cigar-shaped projectiles that are used to attack other submarines or boats. The word torpedo comes from the name of a kind of electric ray that numbs you with its sting (torpediniformes).
A missile is a self-propelled projectile designed to travel through the air or space, while a torpedo is a self-propelled projectile designed to travel through water. Essentially, torpedoes are a specific type of missile that operates underwater.

Missiles
Any self-propelled projectile, including those designed for air, space, or water travel.
Types: Can be short-range, medium-range, or long-range, and can include ballistic missiles, cruise missiles, surface-to-air missiles, etc.
Guidance: Can be guided or unguided, with various guidance systems used to direct the missile to its target.

Torpedoes
Definition: A self-propelled missile designed for underwater travel, typically launched from ships, submarines, or aircraft.
Purpose: Primarily used for anti-submarine warfare and attacking surface vessels.
Guidance: Modern torpedoes can be guided by various means, including sonar and wire guidance, allowing them to track and attack targets.[6]

Figure-6: Torpedo and Missile explosion.

Key Differences
Environment: The primary difference is the medium they travel through. Missiles are designed for the air or space, while torpedoes are designed for water.

Target: Missiles can target various objects in the air, space, or on the ground, while torpedoes primarily target underwater targets.

Technology: Torpedoes often utilize underwater technologies like sonar, while missiles rely on a wider range of technologies depending on the missile type. A torpedo's composition typically includes a warhead, a guidance and control system, a fuel tank, and a propulsion system. The warhead contains the explosive charge, which can vary but historically includes mixtures like Torpex (a mix of RDX: 1,3,5-Trinitroperhydro-1,3,5-triazine, TNT: 2,4,6-trinitrotoluene, and aluminum) or more modern compositions like PBX. The guidance system allows the torpedo to navigate towards its target, using methods like wire guidance or sonar. The propulsion system provides the necessary thrust, which can be achieved through various means, including electric batteries, monopropellants (like Otto fuel II), or bipropellant. A modern torpedo's inner structure consists of three main parts: a propulsion system, a guidance system, and a warhead. Additionally, it includes mechanisms for depth and direction control, and a firing device. The torpedo's body is typically made of aluminum.[7]

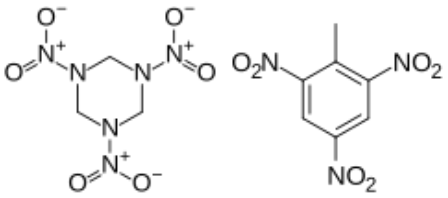

Figure-7: RDX & TNT.

Propulsion System: Most modern torpedoes use electric motors powered by batteries for underwater propulsion.
Guidance System: This system uses sonar (either active or passive) to locate and track the target. It can also include wire guidance for two-way communication with the launch platform and more advanced systems for over-the-horizon targeting.
Warhead: This is the explosive charge, designed to detonate upon impact or proximity to the target.
Control Systems: Torpedoes have mechanisms to control their depth and direction, often using preset plans or signals from the guidance system.
Firing Mechanism: This device triggers the detonation of the warhead when the torpedo reaches its target.
Structural Components: The torpedo's body is designed to withstand the pressures of underwater travel and the forces involved in launching and impact. This includes a nose cone, a main body, and a tail section. The body is often made of aluminum and may include stiffening rings and longitudinal stiffeners.[8-10]

CONCLUSION

Yes, a submarine is a type of warship. Submarines are naval vessels designed to operate both on and beneath the water's surface, giving them a unique tactical advantage. They are equipped with various weapons, including torpedoes and missiles, and are used for a variety of missions, including attacking other ships, defending friendly forces, and strategic deterrence.

REFERENCE

1. Jones, G. P. (1986). Submarines versus U-Boats. London: William Kimber. ISBN 978-0-7183-0626-7.
2. Preisler, J.; Sewell, K. (2013) [2012]. Code-Name Caesar: The Secret Hunt for U-boat 864 during World War II (repr. Souvenir Press, London ed.). New York: Berkley Books. ISBN 978-0-285-64203-4.
3. L. Türker, Thermobaric and Enhanced Blast Explosives (TBX and EBX), Defence Technology, 2016; 12: 423–445.
4. J. L. Gottfried, D. K. Smith, Chi-Chin Wu, M. L. Pantoya, Improving the Explosive Performance of Aluminum Nanoparticles with Aluminum Iodate Hexahydrate (AIH), Sci. Rep, 2018; 8(1): 8036.
5. W. A. Trzciński, L. Maiz, Thermobaric and Enhanced Blast Explosives – Properties and Testing Methods, Propellants Explos. Pyrotech, 2016; 40: 632–644.
6. P. P. Vadhe, Rajesh Pawar, R. K. Sinha, S. Asthana, A. Subhananda Rao, Cast Aluminized Explosives (Review), Combust. Explos. Shock Waves, 2008; 44(4): 461–477.
7. B. E. Gelfand, S. P. Medvedev, S. V. Khomik, M. V. Silnikov, Comparative Study of Pressure-temperature Effects from TNT and RDX-IPN−Al Explosives, Military Aspects of Blast and Shock, MABS20, Oslo, 2008; 1–8.
8. J. K. Chen, T. B. Brill, Chemistry and Kinetics of Hydroxyl-terminated Polybutadiene (HTPB) and Diisocyanate-HTPB Polymers During Slow Decomposition and Combustion-like Conditions, Combust. Flame, 1991; 87: 217–232.
9. V. I. Berezkin, Nucleation and Growth of Closed Many-layer Carbon Particles, Phys. Status Solidi B., 2001; 226(2): 271–284.
10. G. Antić, V. Džingalašević, M. Stanković, Z. Borković, Explosive Characteristics of Cast PBX Based on HMX, Ammonium Perchlorate and Aluminium, Sci.-Tech. Rev, 2004; 54: 38–44.