WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 4, Issue 11, November, 2023

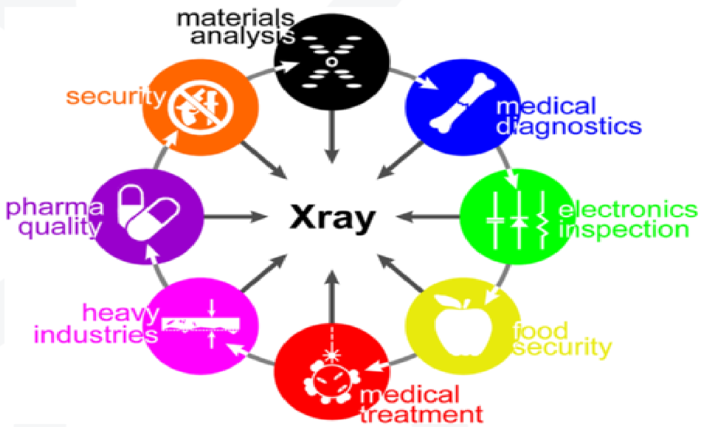
X-RAY GENERATION USING CARBON NANOTUBES

Olimjonova Go'zal Olimjon qizi
Assistant Tashkent Medical Academy, Tashkent, Uzbekistan

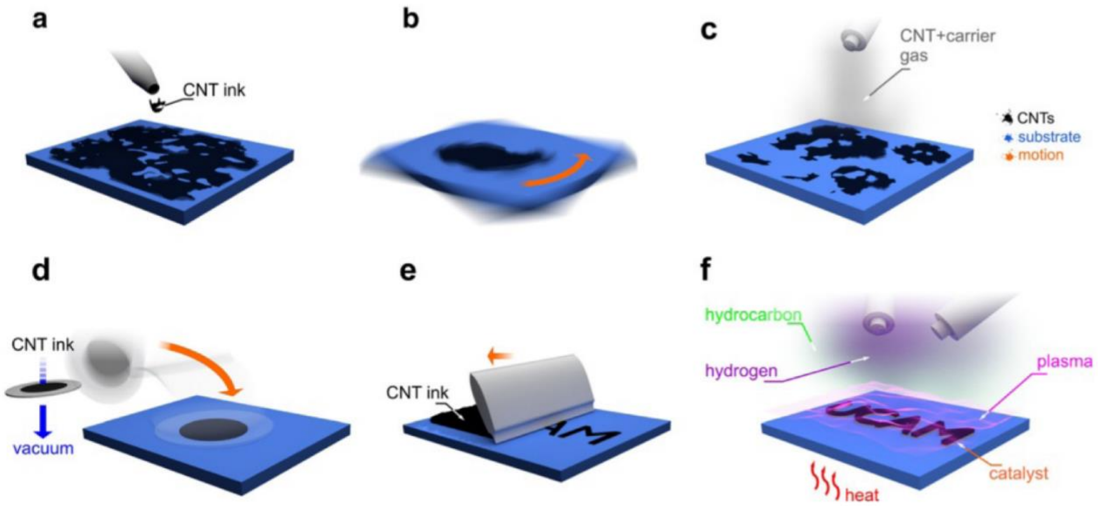
Abstract
Since the discovery of X-rays more than a century ago, the techniques used in X-ray source engineering have remained relatively unchanged. It remains central to almost all X-ray applications due to its simplicity of manufacture. At the same time, it has its place in computer and tomographic synthesis, medical and inspection techniques, safety inspection and radiotherapy. When combined with the emerging field of nanomaterials, and carbon nanotubes in particular, such systems present a unique technological opportunity. Currently, carbon nanotubes are used as sources of X-rays. Since the discovery of X-rays in 1895, X-ray analysis and diagnostics have been one of the most studied areas in science and technology.

Keywords: nanotube, X-ray tube focus, nanocomposite.

Nearly half of the Nobel Prizes awarded in the first quarter of the 20th century were for work in this discipline. Since J.J. Thomson had already demonstrated that X-rays are ionizing radiation, it was known that they have various characteristics, which were originally classified as "hard," "medium," and "soft."
Applications for X-ray sources include border control, food safety, electronic inspection, and medical diagnostics. Electrons released from the cathode are directed toward the anode, which is subjected to a high vacuum and a positive voltage. When a metal surface is exposed to a strong electric field, electron emission happens. Applications of carbon nanotubes for field emission: Carbon nanotubes (CNTs) were discovered in the early 1990s.



The largest aspect ratio, second-order electron coefficient, low chemical reactivity in an oxidizing atmosphere, high thermal conductivity, strong parallelization in bulk, and insensitivity to direct ion bombardment are all characteristics of carbon nanotubes (CNTs). The significant functional and performance advantages of CNT-based emitting electrons over traditional X-ray sources are due to their unique characteristics. Significant issues with CNT electron source production, dependability, time stability, spatial uniformity, and reproducibility have impeded the advancement and broad use of the technology. Following the discovery of CNTs, Sugie et al. proposed CNT-based X-ray sources in 2001. In most indicators, field emitters based on graphene and CNT perform better than such sources [7-8]. It is simple to pattern CNT thin films using a range of methods.



General carbon nanotube thin film deposition technique.

INTERVENTIONAL USE OF MICROFOCUS X-RAY IN MEDICINE

The use of nanomaterials in the microfocus X-ray technique is becoming relevant because, in them, the high density of electron currents is realized on small surfaces (focal spots) [1]. It is known that the focus of the X-ray tube is an important characteristic of all X-ray tubes, which affects the quality of the obtained image. An X-ray tube consists of a glass tube with different ends soldered with two electrodes: an anode and a cathode. When a voltage is applied to the cathode, a stream of accelerated electrons comes out of it, and as a result of a collision with the surface of the anode, it slows down sharply. The surface of the anode facing the cathode is called the anode mirror. When hitting the anode glass, a large amount of the kinetic energy of the electrons is converted into heat and a small amount into X-rays. [4]

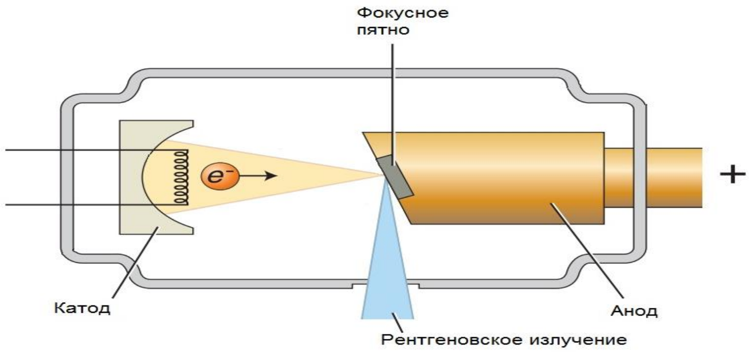
The surface of the anode where the electrons collide is called the focal spot of the X-ray tube. The whole of the anode is not involved in X-ray diffraction because the focus represents a small circular or rectangular surface. In order to obtain different images, some tubes are equipped with two focal points of different sizes. As the size and shape of the electron target change, the shape and size of the focal spot of the X-ray tube also change. The shape and size of the electron stream, in turn, depend on the shape of the cathode and focusing devices.

The following focal spot sizes are common:

• 0.3 and 0.6 mm, usually used in mammography;

• 1.0 and 1.2 mm, often used in general radiography.

The optical property of the tube depends on the size of the focus. Reducing the focus increases the clarity and sharpness of the image, because in this case, the quality of the X-ray source is similar to that of a point source.



Focus size and shape

That is, the feature of the maximum accuracy of the image formed on the X-ray device increases in the small size of the focal spot. During the generation (production) of X-rays, the surface of the anode heats up quickly due to the release of a large amount of heat, but the temperature in the outer layers of the anode practically does not change. The following technologies are used to prevent deformation of the anode path, cracks and unevenness in it: materials resistant to high temperatures - tungsten or its alloy with rhenium - are used to make the anode glass, and often the tungsten glass is mounted on a molybdenum base . As a result, the surface of the glass withstands a much higher temperature, that is, it leads to an increase in the power of the radiator.

Conclusion

Nowadays, diseases of the respiratory system are on the rise on a large scale, as a result of which X-ray devices are very important for us, their accurate and effective results. Due to the properties of nanomaterials, it is required to use them to create safe and highly effective devices for patients. Carbon nanotube is a one-dimensional quantum material with a special structure. Forms multi-layered coaxial circular tubes.

Keep the distance between the layers around 0.34nm, and the diameter is usually 2-20nm, and according to the different directions of the axial direction of the carbon hexagon, it can be divided into three types: zigzag, armchair and spiral. Among them, helical carbon nanotubes have chirality, while zigzag and armchair carbon nanotubes have no chirality. It is the properties of CNT-based emitting electrons that have many functional and performance advantages over conventional X-ray sources. Serious problems related to the fabrication, reliability, time stability, spatial uniformity, and reproducibility of CNT electron sources have hindered the development and widespread adoption of the technology. After the advent of CNT, and in 2001, Sugie et al. successfully designed and proposed CNT-based X-ray sources. Field emitters based on CNT and graphene outperform such sources in most indicators.

References

1. Золотухин И.В., Калинин Ю.Е. Замечательные свойства углеродных нанотрубок // Природа. 2004. № 5.
2. Heo S.H. et al. X-ray tubes with carbon nanotubes cathode // Appl. Phys. Lett. 2007. 90. 183109.
3. Sugie H., Tanemura M., Filip V. et al. Carbon nanotubes field-emission cathode // Appl. Phys. Lett. 2001. Vol. 78. 2587.
4. Senda S., Sakai Y., Mizuta Y., Kita S. and Okuyama. Surer - miniature X-ray tube // Applied Physics Letters. 2004. Vol. 85. № 3.
5. Zhan J. et al. Stationary Scanning X-ray source based on carbon nanotube field emitters // Applied Physics Letters. 2005. Vol. 86. 184104.
6. Добрецов Л.Н., Гомоюнова М.В. Эмиссионная электроника. - М.: Наука, 1966.
7. Рахимов А.Т. Автоэмиссионные катоды (холодные эмиттеры) на нанокристаллических углеродных и наноалмазных пленках (физика, технология, применение) // Успехи физических наук. 2000. Т. 70. № 9. С. 996-999.
7. Мулюков Р.Р., Юмагузин Ю.М. Работа выхода электронов из нанокристаллического вольфрама // Доклады Академии наук. 2004. Т. 399. № 6. С. 760-761.
8. Васильев А.Ю., Потрахов Н.Н., Серова Н.С. и др. Микрофокусная рентгенография - от прошлого к будущему // Петербургский журнал электроники. № 2-3. С. 19-25.
9. Блинов Н.Н., Васильев А.Ю., Серова Н.С., Грязнов А.Ю., Потрахов Н.Н. Микрофокусный способ получения фазоконтрастных рентгеновских изображений // Медицинская техника. 2009. № 4 (256).

ISSN: 2776-0979, Volume 4, Issue 11, November, 2023

10. Алексеев С.В., Таубин М.Л., Ясколко А.А. К вопросу о применении наноструктурных материалов в медицинской технике // Медицинская физика. 2008. № 2.
11. Алексеев С.В., Таубин М.Л., Ясколко А.А. Наноструктурные и монокристаллические материалы для медицинской техники / Материалы II Всероссийского национального конгресса по радиологии, 2008 г.
12. Alekseev S., Taubin M., Yaskolko A. Application of nanostructural materials in medical technic / 20th Workshop ISTC in Korea «Nanomaterals and nanotechnology», Seul, 2009.