



## Editorial

# The Nano4XX Nanotechnology Platform: The Triumph of Nanotechnology

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If a person is diagnosed with cancer, doctors recommend surgery, chemotherapy, and radiotherapy [1]. In the case of chemotherapy, there are visible and invisible phenomena that no one can avoid. Some are visible, such as hair loss, and others are hidden, such as heart toxicity. How can we target the cancer but leave the organs untouched by these toxic chemicals? To date, no one has considered that cancer differs from healthy organs. Cancer has a temperature of 37 degrees Celsius, the redox is different from the rest of the organs, and its pH is between 3.8 and 4.5 [1]. If we want to develop drugs that target cancer, we need to consider these parameters and create drug delivery systems that recognize these cancer properties. If a drug transporter also has a targeting molecule, then in this way, we will target the tumor and get the best results. We need to give these drug delivery bodies the ability to automatically target and recognize cancer on their own so that we get the best results, namely targeted chemotherapy.

Drug carriers were developed for this purpose and consist of three shells, i.e., three different polymers. The first polymer is sensitive to pH, the second polymer is temperature sensitive, and the third polymer is susceptible to cancer redox. These carriers are charged with bulk chemotherapy drugs that are commercial. The surface of these carriers is equipped with magnetic nanoparticles so that they can be used for hyperthermia. Additionally, these drug carriers are fitted with gadolinium so that we can observe them using the Magnetic Resonance Imaging (MRI) technique. Finally, we equip the drug delivery systems with fluorescent probes to monitor them using fluorescence spectroscopy. Figure 1 shows such a DDS comprising three shells [2]. These DDSs are overloaded with doxorubicin, cisplatin, etc. A targeting molecule is placed on the surface of the DDS to find breast cancer via folic acid and prostate cancer via leuprolide [3].

A scientist developing such a new DDS must solve several challenges and determine if one can exploit this DDS commercially. The first questions we must answer are whether this drug delivery system is toxic, whether it enters the cancer cell, and how it is dispersed in the body; in addition, we must discover its toxicity to various organs and, finally, whether there is a treatment [4–7]. In other words, the inventor must prove that this new drug delivery system solves all the problems of chemotherapy and leads to better therapeutic results. Because the system we developed has a quadruple response to cancer, we named it Nano4XX; XX is the commercial drug we charge it: doxorubicin, cisplatin, etc.

A key question is whether this platform enters cancer. This question was answered with the two experiments illustrated in Figure 2. For these experiments, we used the platform, which in one case had no folic acid targeting molecules (Figure 2A), while in the second, we used a platform modified superficially with folic acid (Figure 2B). In the first case, we see that the platform is piled out of the cancer cells, as shown by the green light emanating from the Fitc. In the second case, the platform surrounds the cancer cells and colors them green because of the Fitc, and because they enter the cancer cells, we see them



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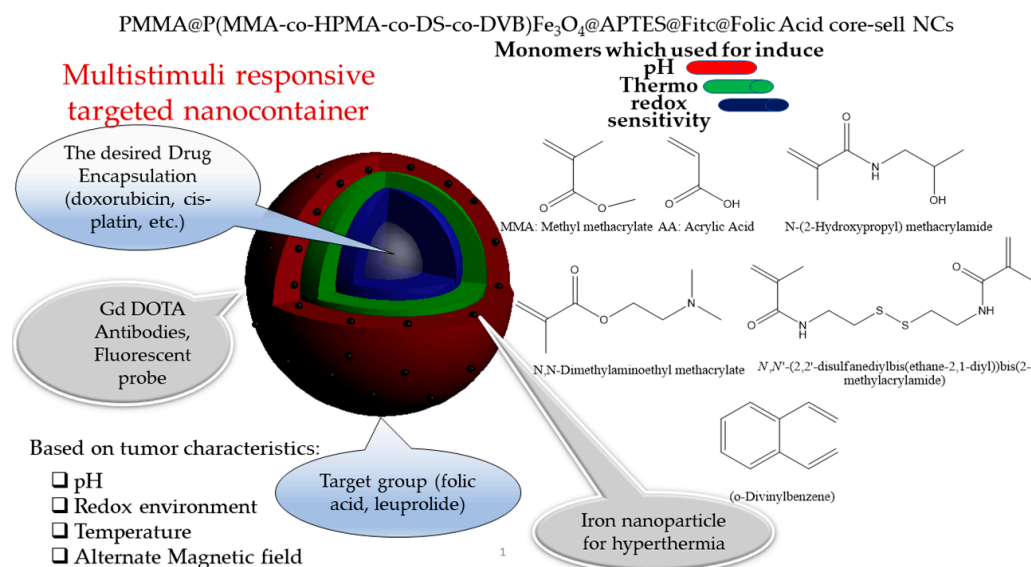
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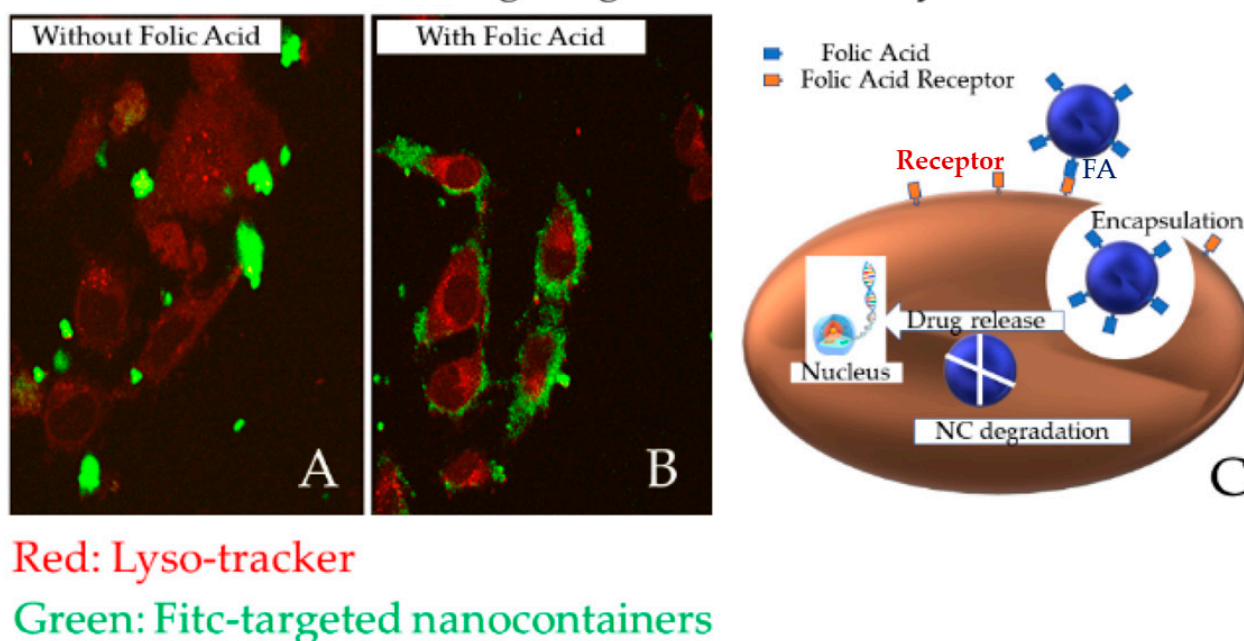
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tinged bright red due to the doxorubicin released due to the breakdown of the platform inside the cancer cells.



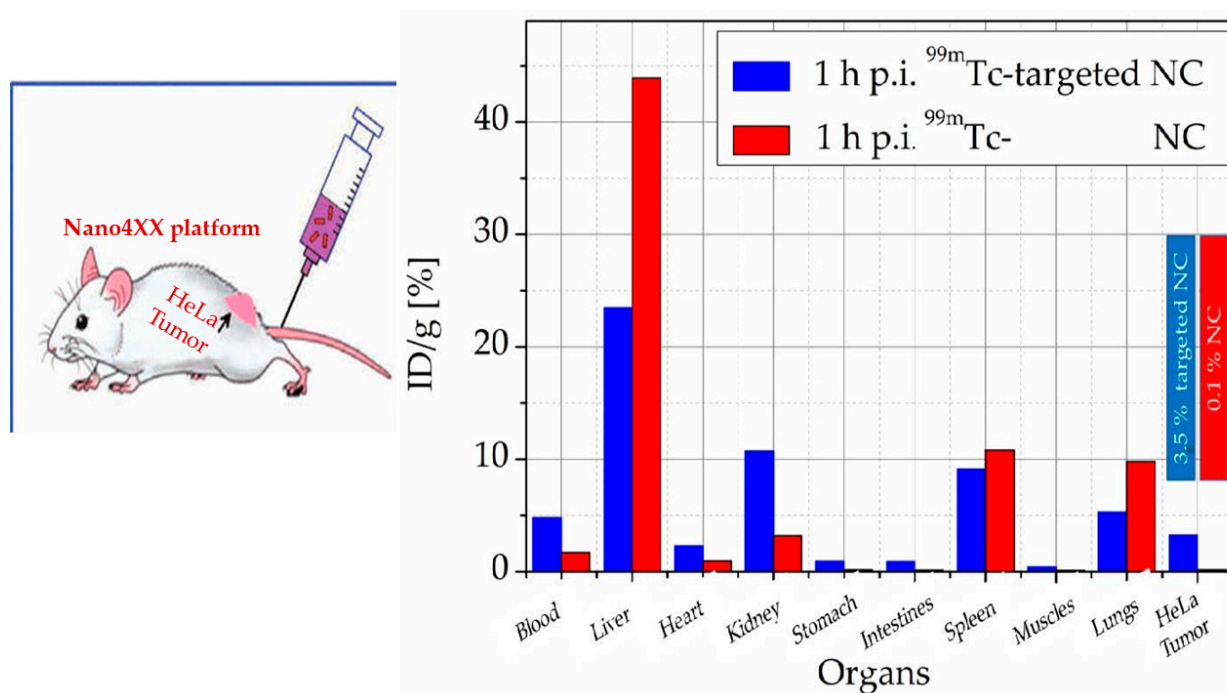
**Figure 1.** The Nano4XX platform consists of three layers, iron nanoparticles, a targeting group, and fluorescent probes.

## Cell studies for targeting to HeLa cells by confocal



**Figure 2.** (A) Nano4Dox piles away from cancer without folic acid and (B) bonded to cancer in the case of the FA-Nano4Dox platform. (C) Mechanism of cancer destruction through adhesion to receptors via folic acid attachment, adsorption to cancer cells via EPR effect, demolition of them because they have the same properties as cancer, and release of doxorubicin in cancer cells, which colors cancer cells red, thus therapy.

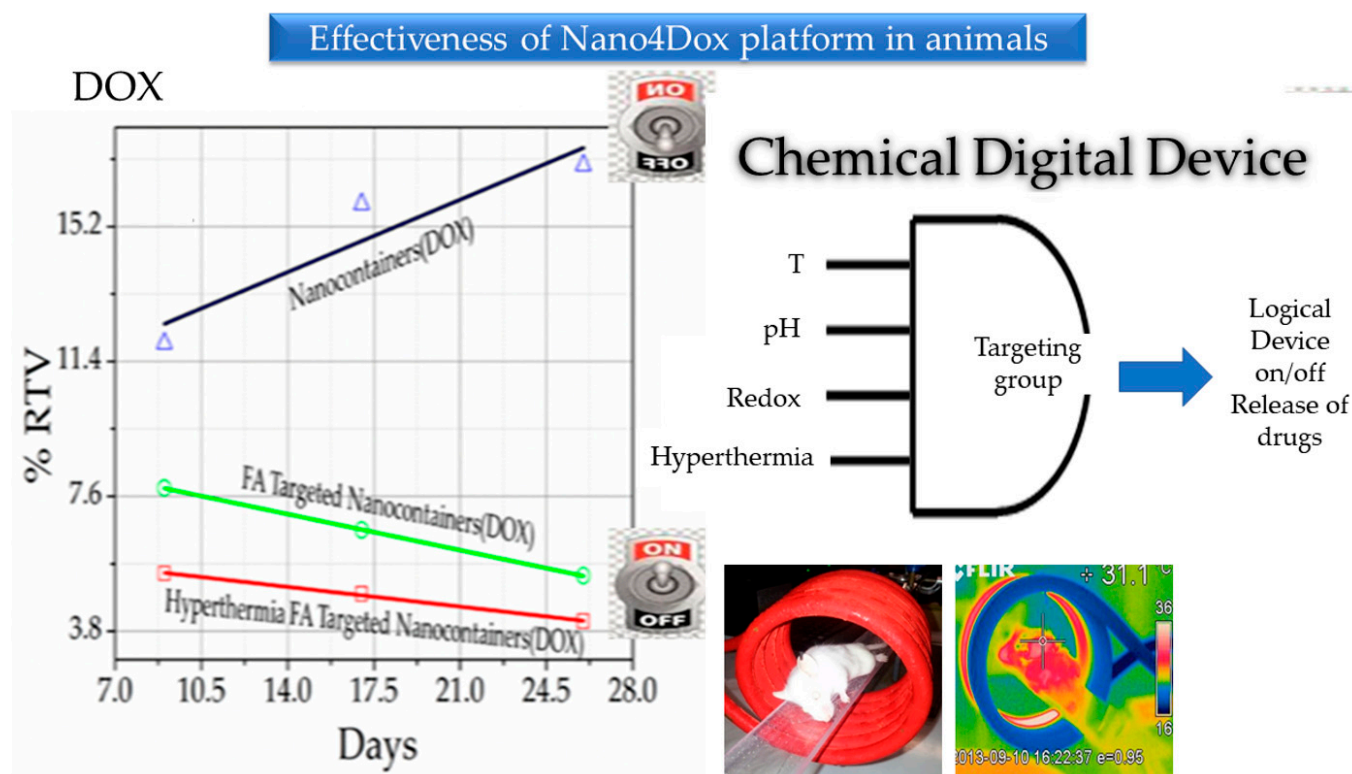
The platform was injected into the body and directed to various organs, including cancer. However, we must also answer the following question: what percentage of the platform will go to the different organs when it is free of folic acid and with folic acid grafted? These percentages were determined using the PET method described in detail in the literature [5]. Figure 3 shows this distribution in the various organs with and without folic acid forts. We see a significant difference in the distribution in different organs with and without folic acid, but what is striking is the distribution of the platform in cancer cells with and without folic acid, which is 3.5% and 0%, respectively.



**Figure 3.** Dispersal of the Nano4Dox in organs: F.A. grafted (blue bar) and without F.A. grafted (red bar).

At the end of this research, we examined whether the platform had a therapeutic effect. We repeated three experiments several times to ensure the reliability of the results [8]. Figure 4 shows the results of this research; in the first case, the increase in volume over time is depicted on the platform that has not been modified with folic acid, while in the second case, the platform has been grafted with folic acid, and we see a decrease in volume—specifically, over 25 days, we measured a 30% decrease in volume. We placed the mouse in a hyperthermia machine and noticed the therapeutic effect improved in this case. With these measurements, the original goal was achieved in that we built a digital platform that releases the drug into cancer when the temperature, pH, redox, and the molecule in the joints recognize cancer where, with these conditions, the drug is released. The drug is not removed when the platform finds elevated sepsis temperature areas. In this case, only the T condition is satisfied, which is not enough to release the drug because the rest of the conditions seal the release of the drug. This development can be considered a revolution in cancer treatment through the platform we developed.

The platform we developed in this work leaves the drug in the cancer and healthy organs intact, significantly reducing cancer over time. This method can be used in all kinds of cancer, and we can use all commercial drugs. The platform is protected by a worldwide patent detailing the results of this research [9]. This platform can also be used in various diseases, such as diabetes.



**Figure 4.** The therapeutic effect of the Nano4Dox platform in animals to heal a tumor.

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