Opinion

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Magnetic Heating and Anti-Cancer Nonmagnetic Nano Systems

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ABSTRACT

Cancer is known for higher mortality rates. If not detected in early stages, it can lead to loss of lives. Most of the therapies involved in treatment of cancer are accompanied by several undesirable effects in patients. As such, the need for a novel treatment is of immense requirement. This brief article outlines the potential possessed by magnetic heating as well as anticancer nonmagnetic nano systems.

Introduction

Cancer falls into the category of dreaded diseases. What is observed in a patients' body is uncontrolled growth as well as spreading of abnormal forms of own living cells. In the same note, cancer cells can be distinguished from the normal by unique characteristics such as proliferation in an uncontrolled manner, functional loss, invasiveness, and metastasis. Once the cells undergo these transformation, criticality of the patient also enhances. To tackle this, there must be ways of early-stage detection so that mortality rate can be checked. With the advent of nanotechnology, it has become possible to dramatically improve on current approaches to cancer detection, diagnosis, imaging, and therapy while reducing toxicity associated with traditional cancer therapy. It is pertinent to mention here that existing cancer therapies are far too invasive, painful, toxic, and associated with too many acute and chronic side effects. Over the last three decades, rate of cancer cure encompassing major human malignancies have not improved so much over the last three decades. If we have a look at the three-year report of population-based cancer registries (2009-11) as issued by Indian Council of Medical Research (ICMR), India, the statistics reveal a varying pattern of cancer types with a heterogenous demographic distribution in the subcontinent. Among female, cancer of the breast and cervix are the leading site of cancer in 18 of 25 population-based cancer registries (PBCRs). In this regard, it can be asserted that novel treatment approaches based on nanotechnology will provide higher efficiency in curing patients and minimizing toxicity at the same time.

Discussion

Ensembles of interacting nanoparticles have interesting collective properties that are much different from the individual nanoparticles as well as their bulk counterparts. When magnetic nanoparticles are organized in 2D superlattices, their collective magnetic behavior varies greatly than the individual entity. In such a concentrated ensemble, the magnetic behavior is strongly affected by interparticle interactions predominantly over the size of individual nanoparticles [1-5]. Such magnetic ensembles offer a unique way of engineering their magnetic response by modifying the strength of the dipolar interactions existing between the magnetic nanoparticles. As a result, interacting magnetic nanoparticles have garnered a lot of interest because of their rapidly increasing areas of application ranging from magnetic recording to biomedicine. It will be of great importance to see the application of magnetically interacting nanoparticle ensembles in the field of biomedicine. Heating magnetic nanoparticles in an alternating magnetic field, popularly known as magnetic-fluid hyperthermia

(MFH), is a promising non-invasive cancer treatment technique [3-8]. The heating efficiency of the nanoparticles is expressed in terms of the specific absorption rate (SAR) of the magnetic nanoparticles (MNPs). Active efforts are going on to increase the SAR value so that minimal particle concentration can produce the desired therapeutic temperature in the tumor site. The SAR value of MNPs is reported to be dependent on various parameters, such as, mean particle size and the size distribution, the shape, the crystalline anisotropy, the surface coating thickness, the concentration, and the degree of agglomeration.

Concluding remarks

However, controlled magnetic nano ensembles formed by the aggregation of MNPs can play an important role in influencing the SAR value. The dipolar interaction existing in concentrated nanoparticle ensembles acts as a crucial parameter affecting the magnetic heating characteristics of nanoparticles in hyperthermia application [4]. Though it is known that the "magnetic hysteresis loss" and the "relaxation loss" are responsible for the magnetically induced heating temperature, the contribution of the magnetic hysteresis loss is more dominant in increasing the heating temperature [5]. Hence, it is assumed that by controlling the magnetic dipole interaction among the nanoparticles one can directly tune the magnetic hysteresis loss because the particle dipole interaction would directly influence the change in magnetic susceptibility and moment of magnetic nanoparticles. However, previous reports show that the SAR value dropped with the increase in dipolar interaction [6-8]. There are reports which showed a higher SAR value of concentrated nanoparticle ensembles in comparison to the loosely bound nanoparticles [7-10]. Thus, it can be concluded that the role of particle dipole interaction on the ac magnetically induced heating characteristics of magnetic nanoparticles needs to be reviewed both theoretically as well as experimentally for better understanding.

References

1. L Bardotti, F Tournus, C Albin, O Boisron, V Dupuis (2014) Self-organisation of size- selected CoxPt1-x clusters on graphite. Phys Chem Chem Phys16: 26653.
2. M Vasilakaki, C Binns, KN Trohidou (2015) Susceptibility losses in heating of magnetic core/shell nanoparticles for hyperthermia: A Monte Carlo study of shape and size effects. Nanoscale 7: 7753-7762.
3. Y Qu, J Li, J Ren, J Leng, C Lin, D Shi (2014) Enhanced Magnetic Fluid Hyperthermia by Micellar Magnetic Nanoclusters Composed of MnxZn1−xFe2O4 Nanoparticles for Induced Tumor Cell Apoptosis. ACS Appl Mater Interfaces 6(19): 16867-16879.
4. M Jeun, S Bae, A Tomitaka, Y Takemura, KH Park, et al. (2009) Effects of particle dipole interaction on the ac magnetically induced heating characteristics of ferrite nanoparticles for hyperthermia. Appl Phys Lett 2 95: 082501.
5. A Urtizberea, E Natividad, A Arizaga, M Castro, A Mediano (2010) Specific absorption rates and magnetic properties of ferrofluids with interaction effects at low concentrations. J Phys Chem C 114: 4916-4922.
6. P de la Presa, Y Luengo, M Multigner, R Costo, MP Morales, et al. (2012) Study of heating efficiency as a function of concentration, size and applied field in c-Fe2O3 nanoparticles. J Phys Chem C 116: 25602-25610.
7. Y Qu, J Li, J Ren, J Leng, C Lin, et al. (2013) Learning from nature to improve the heat generation of iron-oxide nanoparticles for magnetic hyperthermia applications. Sci Rep 3: 1652.
8. CL Dennis, AJ Jackson, JA Borchers, PJ Hoopes, R Strawbridge, et al. (2009) Nearly complete regression of tumors via collective behavior of magnetic nanoparticles in hyperthermia. Nanotechnology 20: 395103.
9. R Biswas (2020) Nanosponges: A viable option for combating Covid-19. J Clinical Research and Reports 5(4): DOI:10.31579/2690-1919/121.
10. R Biswas (2020) Wearable biosensors: A gigantic leap in health care system. Int J Biosen Bioelectron 6(4): 103-104.

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