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Iron-containing nanoparticles for cell-mediated hyperthermia

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Using magnetic nanoparticles to absorb alternating magnetic field energy as a method of generating localized hyperthermia has been shown to be a potential cancer treatment. We are developing delivery systems that use tumor homing cells to actively carry iron/iron oxide nanoparticles into tumor tissue. We have developed strategies to change the ligand spheres of superparamagnetic iron/iron oxide nanoparticles to facilitate their rapid uptake by cells capable of ameboid movement. This approach comprises the synthesis of nanoparticles in microemulsions, the exchange of the nanoparticles' organic ligands after synthesis, and the formation of double-layers around an iron/iron oxide core (ferrosomes). In addition to making the nanoparticles sufficiently water soluble, we have been exploring uptake-enhancing peptide sequences, as well as the attachment of small molecules. To date, we have been testing tumor-tropic neural progenitor cells, endothelial precursor cells, monocyte/macrophage-like cells and neutrophils.

We have used murine models of disseminated peritoneal pancreatic cancer, metastatic melanoma, and metastatic breast cancer. After tumor development, the transport cells loaded with iron/iron oxide nanoparticles were injected either intraperitoneally or intravenously and then allowed to migrate into the tumor. The mice were then exposed to an alternating magnetic field for 20 minutes to cause the cell-delivered nanoparticles to generate heat. We could demonstrate that cell-mediated A/C-magnetic hyperthermia is a viable alternative to intratumoral injection or intravenous injection of nanoparticles. The advantage of cell-delivered methods is that the total amount of nanoparticle required is distinctly lower. Depending on the nature of the delivery cells, different sites within the tumor can be targeted.

Biography

Stefan Bossmann has completed his Ph.D in Chemistry at the age of 28 years from The University of Saarland/Germany, and his habilitation in Chemical and Process Engineering at the age of 34 from the University of Karlsruhe/Germany. He was a postdoctoral research associate of Columbia University in the City of New York. He was assistant and associate professor of Chemical and Process Engineering at the University of Karlsruhe and partner of the company Mycotek (Erlangen/Germany). Since 2004, he is Professor of Chemistry at Kansas State University. He has published more than 125 papers in reputed journals, 10 book chapters and more than 200 conference reports. He holds 8 patents.

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