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Magnetic Resonance Contrast Agents for Medical and Molecular Imaging

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1. INTRODUCTION

This chapter focuses on the wide range of chemical and biological applications that exist for magnetic resonance imaging (MRI) contrast agents. We begin with a brief introduction of how MRI and contrast agents function followed by a review of both clinical and experimental uses for MRI contrast agents. We proceed with a description of the targeted delivery of contrast agents including how they bind to and accumulate in specific biological tissues. Finally, we describe the new class of bio-activatable MR contrast agents. These agents respond to a biological phenomenon by altering the intensity of the observed signal in a conditional fashion.

1.1. Magnetic Resonance Imaging

MRI has become an extremely important tool for clinical diagnosis of disease and as a noninvasive method of acquiring threedimensional images of opaque experimental animals. MRI is based on the same principles as nuclear magnetic resonance (NMR) spectroscopy. Briefly, samples are placed in a large magnetic field and exposed to radiofrequency (rf) pulses. The relaxation times of the excited nuclei (usually protons from water)

are then detected. Water pr
is typically weighted using
T_2 (spin-spin relaxation tim
and inhomogeneous (e.g. w
In order to create an image
mation is encoded into the
gradients that alter the magn
of spatial positions to freque
formed to produce images fi

Since the development
have led to increases in both
conducting magnets have m
image resolutions possible
nets. Modern computers an
image quality and decreased
obtained in minutes (single s
tion as X-ray computed tom
Where higher fields (>10 T
cells (~10 μm) have been re
of the primary imaging mo
source for a complete desc
Chemistry of Contrast Age
edited by Merbach and Tóth
thanides and Their Interrela

1.2. Classes of Contrast A

MRI can distinguish betwe
ferences in water concentra
contrast agents improve im
optical dyes such as fluores
contrast as a result of the
magnetic molecules, becau
MRI contrast agents. They
nearby proton spins, thus e
image. The mechanism of