

## 4.10: Hazards of Life with Dioxygen

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The binding of dioxygen is normally a reversible process:



Under some circumstances, such as in the presence of added nucleophiles and protons, coordinated dioxygen is displaced as the superoxide anion radical,  $O_2^-$ , leaving the metal center oxidized by one electron and unreactive to dioxygen:<sup>49,50</sup>



For hemoglobin there exists a flavoprotein reductase system, comprising a reduced pyridine nucleotide (e.g., NADH), cytochrome  $b_5$  reductase, and cytochrome  $b_5$ , that reduces the ferric iron back to the ferrous state, so that it may coordinate dioxygen again.<sup>1,51</sup> In addition, all aerobically respiring organisms and many air-tolerant anaerobes contain a protein, superoxide dismutase, that very efficiently catalyzes the dismutation of superoxide ion to dioxygen and hydrogen peroxide:<sup>52-54</sup>



However, the physiological effects of the superoxide moiety remain controversial.<sup>53,54</sup> Finally, there is a third enzyme, the hemoprotein catalase, that converts the toxic hydrogen peroxide into water and dioxygen:<sup>1</sup>



This topic is discussed further in Chapter 5.

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