# Free Radical Nomenclature, Suggestions

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The purpose of this document is to provide an easy reference to some of the language of Free Radical Biology. We provide here a beginning guideline to nomenclature and notation for free radicals and related species. The International Union of Pure and Applied Chemistry (IUPAC) does not provide suggestions on all abbreviations we might use; attached are the suggestions of the FRRB Program. Guidelines for nomenclature in Free Radical Biology can be found in [1,2, 3, and references therein].

## I. Free Radical and Oxidant Notation and Nomenclature

In chemical formulae as well as when using abbreviations, a free radical is denoted by a superscript dot to the right (usually). In the examples below note that if a radical is a charged species, we put the dot and then the charge.

$H^{\bullet}$ $O_2^{\bullet-}$ $CO_2^{\bullet-}$
$HO^{\bullet}$ $^{\bullet}CH_3$
$O_2^{\bullet\bullet}$ or $O_2^{2\bullet}$ would be the radical notation for ground state dioxygen

**Table 1. Formulae and IUPAC Recommended Names of Simple Compounds Containing C, H, and O in Free Radical Biology**

| Species | Systematic Name | Alternative and Comments |
|---|---|---|
| $O^{\bullet-}$ | oxide(1-) | not found in the 1990 recommendations |
| $O_2^{\bullet-}$ | dioxide(1-) | superoxide and hyperoxide |
| $O_3$ | trioxygen | ozone |
| $O_3^{\bullet-}$ | trioxide(1-) | ozonide |
| $HO^{\bullet}$ | hydroxyl | not hydroxy, hydroxide is restricted to $OH^-$ |
| $HO_2^{\bullet}$ | hydrogen dioxide | hydrodioxyl, hydroperoxyl is allowed, but perhydroxyl does not make sense |
| $HO_2^-$ | hydrogendioxide(1-) | hydrogenperoxide(1-); hydroperoxide is |

[1] Koppenol WH. (1990) What is in a name? Rules for radicals. *Free Radic. Biol. Med.* **9**:225-227.
[2] Trynham JG. (1986) A short guide to nomenclature of radicals, radical ions, iron-oxygen complexes and polycyclic aromatic hydrocarbons. *Adv. Free Radic. Biol. Med.* **2:**191-209.
[3] Koppenol WH. (2002) NO nomenclature. *Nitric Oxide Biol Chem*. **6:**96-98.

| | | |
|---|---|---|
| | | not recommended |
| $H_2O_2$ | hydrogen peroxide | |
| $RO^{\bullet}$ | alkoxyl | not alkoxy |
| $ROO^{\bullet}$ | alkyldioxyl | alkylperoxyl; not peroxy |
| ROOH | alkyl hydroperoxide | |
| $O{=}NOO^{-}$ | oxoperoxonitrate (1-) | peroxynitrite |
| O=NOOH | hydrogen oxoperoxonitrate | peroxynitrous acid |
| $^{\bullet}NO$ | nitrogen monoxide | nitric oxide |

## II. Free Radical Nomenclature You Should Know

**Table 2 Common Abbreviations**

| Species/Abbreviation* | Name |
|---|---|
| Asc; $AscH^{-}$; $Asc^{\bullet-}$ | ascorbate, general; ascorbate monoanion; ascorbate radical |
| CAT | catalase |
| Desferal® | trade name for deferrioxamine mesylate |
| DETAPAC or DTPA | diethylenetriaminepentaacetic acid |
| DMPO | 5,5-dimethyl-pyrroline-1-oxide, a spin trap |
| EDRF | endothelium-derived relaxing factor |
| EDTA | ethylenediaminetetraacetic acid |
| EPR | electron paramagnetic resonance |
| ESR | EPR, identical |
| G | gauss |
| GPx | glutathione peroxidase |
| GR | glutathione reductase |
| Grx | glutaredoxin |
| GSH | glutathione, not reduced glutathione |
| GSSG | glutathione disulfide; not oxidized glutathione |
| GST | glutathione S transferase |
| LDL | low density lipoprotein |
| MDA | malondialdehyde |
| NBT | nitroblue tetrazolium |
| NOS | nitric oxide synthase |
| PBN | α-phenyl-N-*tert*-butyl nitrone, a spin trap |
| Prx | peroxiredoxin |

| | |
|---|---|
| PhGPx | phospholipid hydroperoxide glutathione peroxidase |
| POBN | α-[4-pyridyl 1-oxide]-N-*tert*-butyl nitrone, a spin trap |
| PUFA | polyunsaturated fatty acid |
| ROS | reactive oxygen species |
| SOD | superoxide dismutase |
| CuZnSOD | copper,zinc-superoxide dismutase |
| MnSOD | manganese-superoxide dismutase |
| FeSOD | iron-superoxide dismutase |
| ECSOD | extracellular superoxide dismutase |
| TBARS | thiobarbituric acid reactive substances |
| Trx | Thioredoxin |

* These are commonly used abbreviations. Others appear in the literature.

## III. Notation for ROS/RNS

**Table 3 Chemical Notation for various ROS/RNS**

| Radicals and Related Species | Name |
|---|---|
| $^1O_2$ | singlet oxygen |
| $H^\bullet$ | hydrogen atom |
| $H^+$ | proton, hydron |
| $HO^\bullet$ | hydroxyl radical |
| $OH^-$ | hydroxide anion |
| $H_2O_2$ | hydrogen peroxide |
| $RO^\bullet$ | alkoxyl radical |
| $ROO^\bullet$ | alkyldioxyl, alkylperoxyl radical |
| ROOH | alkyl hydroperoxide |
| $GS^\bullet$ | glutathiyl radical |
| $^\bullet CH_3$ | methyl radical |
| $^\bullet NO$ | nitrogen monoxide, nitric oxide |
| $^\bullet NO_2$ | nitrogen dioxide |
| $N_2O$ | nitrous oxide |
| $NO_2^-$ | nitrite |
| $HNO_2$ | nitrous acid |
| $NO_3^-$ | nitrate |
| $HNO_3$ | nitric acid |

## IV. Enzyme Reactions You Must Know to Understand Free Radical Biology

*A. The reaction for superoxide dismutase (SOD) is:*

$$O_2^{\bullet -} + O_2^{\bullet -} + 2\,H^+ \xrightarrow{SOD} O_2 + H_2O_2$$

*B. The reaction for catalase (CAT) is:*

$$2\,H_2O_2 \xrightarrow{CAT} O_2 + 2H_2O$$

*C. The reaction for glutathione peroxidase (GPx) is:*

$$LOOH + 2GSH \xrightarrow{GPx} LOH + H_2O + GSSG$$

where L = H is allowed.

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