# Corrigendum: Antenna–load interactions at optical frequencies: impedance matching to quantum systems



2013 Nanotechnology 24 229501

(http://iopscience.iop.org/0957-4484/24/22/229501)

Nanotechnology **24** (2013) 229501 (1pp) doi:10.1088/0957-4484/24/22/229501

# Corrigendum: Antenna–load interactions at optical frequencies: impedance matching to quantum systems

2012 *Nanotechnology* **23** 444001

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Received 20 February 2013
Published 30 April 2013
Online at stacks.iop.org/Nano/24/229501

In our manuscript, we incorrectly equated electrical impedance with wave impedance in equation (3) on page 4 as

$$Z = R - \mathrm{i}X = \sqrt{\frac{\mu}{\epsilon}} = \sqrt{\frac{\mathrm{i}\omega\mu}{\mathrm{i}\omega\,\mathrm{Re}(\epsilon) - \mathrm{Re}(\tilde{\sigma})}}. \qquad (1)$$

$\mu = \mu_0\mu_\mathrm{r}$ and $\varepsilon = \varepsilon_0\varepsilon_\mathrm{r}$ are the complex magnetic permeability and electric permittivity, respectively; $\tilde{\sigma}$ is the complex conductivity.

The two types of impedances are conceptually similar in some respect, but are not equal. Electrical impedance is a measure of the opposition that a circuit presents to the passage of a current when a voltage is applied, i.e., $Z = V/I$. On the other hand, wave impedance of an electromagnetic wave is the ratio of the transverse components (perpendicular with respect to the propagation direction) of the electric and magnetic fields, i.e., $Z = E/H$.

Equation (3) and related text should thus read correctly:

$$Z_\mathrm{elec} = R - \mathrm{i}X, \qquad (2)$$

where $R$ and $X$ are related to the material parameters of the conducting medium [1], and

$$Z_\mathrm{wave} = \frac{E}{H} = \sqrt{\frac{\mu}{\varepsilon}} = \sqrt{\frac{\mathrm{i}\omega\mu}{\mathrm{i}\omega\,\mathrm{Re}(\epsilon) - \mathrm{Re}(\tilde{\sigma})}}, \qquad (3)$$

where $\mu$ and $\varepsilon$ are the complex magnetic permeability and electric permittivity of the homogeneous medium.

This correction does not affect any of the subsequent discussions or conclusions we draw in our paper.

## Acknowledgments

We thank George Hanson (University of Wisconsin-Milwaukee) for pointing out this oversight, and Honghua Yang for helpful discussions.

## References

[1] Jackson J D 1998 *Classical Electrodynamics* 3rd edn (New York: Wiley) equations 6.139 and 6.140

 