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libRL: A Python library for the characterization of microwave absorption

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Summary

Ever since the revelation that reflection loss as a parameter of interest was shown to not be the defining characteristic of radar-absorbing materials (RAM) (Green & Chen, 2019; Green, Liu, et al., 2019; Green, Tran, et al., 2019), the RAM development community has been bereft of the tools necessary to determine the parameters desired by the new RAM performance hierarchy. Elucidating the new parameters of interest, such as the effective bandwidth, requires non-trivial derivations and calculations that many labs in the RAM community are simply not prepared to handle, at least not at the scale necessary for thorough characterization.

In order to best mitigate these difficulties, presented herein is a Python library for reflection loss characterization, designed for open use by the RAM development community. The libRL library contains functions and procedures which take permittivity and permeability data derived from experimentation, and calculates the various sets of parameters desired for the full characterization of radar-absorbing materials. Such calculations include the standard reflection loss over frequency · thickness grid space, the full list of characterization values defined in the recent literature review, *Recent Progress in Nanomaterials for Microwave Absorption* (Green & Chen, 2019), and finally the effective bandwidths for reflection loss. As such, the library encapsulates the entirety of cutting-edge analyses available for the development of single plane-wave absorbers (Meena, Bhattachrya, & Chatterjee, 2010; Naito, 1969; Naito & Suetake, 1971). These functions have been optimized for both user and computation efficiency, making use of both pythons built-in functions and the cython library for optimized computation performance.

This library can be installed via `pip` and `git` into the user's python environment (see the library docs for details) and imported/used similarly to any other module available in the standard library. libRL includes therein an exhaustive set of methods for customizing the calculation parameters so to satisfy the broadest of scopes necessary for the RAM development community - users are encouraged to consult the docstrings therein for a full description of the customizations available.

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Conflict of interest

Authors declare that there are no conflicts of interest.

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