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Aqueous flat cells perpendicular to the electric field for use in electron paramagnetic resonance spectroscopy[*1]

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Abstract

An analytic solution of the Maxwell equations for aqueous flat cells in rectangular TE_{102} cavities has led to the prediction of significant (3–6 times) X-band EPR signal improvement over the standard flat cell for a new sample configuration consisting of many flat cells oriented perpendicular to the electric field nodal plane. Analytic full wave solutions in the presence of sample and wall losses have been obtained and numerically evaluated. Observation of the predicted fields led to a classification of three distinct types of sample loss mechanisms, which, in turn inspired sample designs that minimize each loss type. The resulting EPR signal enhancement is due to the presence and centering of a tangential electric field node within each individual sample region. Samples that saturate with the available RF magnetic field and those that do not are considered. Signal enhancement appears in both types. These observations, done for the TE_{102} mode, carry over to the uniform field (UF) modes, a relatively new class of microwave cavities for use in EPR spectroscopy developed in this laboratory. Rectangular UF modes have an RF magnetic field magnitude that is uniform in a plane. Based on this analysis, a practical multiple flat-cell design is proposed.

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*1 *Abbreviations:* EPR, electron paramagnetic resonance; RF, radio frequency; TE, transverse electric, TM, transverse magnetic.