Progress meeting BEP

Goal 1: Implement a tool and write the procedure to calculate the participation ration of sources of losses of any qubit geometry.

Limiting source of decoherence in transmon qubits is currently believed to be Two-level systems in lossy layers at different interfaces of the structure.

Parametrization of qubit design to be able to discern the influence of variables (such as pad separation, ground separation, corner radius…) on participation ratios.

Model of the System:

Assumption: Because the lossy layers on interfaces are very thin, E does not change over its thickness.

By law:

*E*-field must always be perpendicular to metal surfaces.

Continuity of

From simulation:

We know the field

Calculation of field in lossy layers:

MV

MS

SV

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| Default model parameters |  |
| Pad thickness | 300 nm |
| Substrate thickness | 520 um |
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| Three lossy layers are defined: Substrate-Air, Metal-Air and Metal-Substrate |
| A fourth lossy layer must be defined when DRIE is used in the production of the qubit |
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| Problem | Failed methods | Solution |
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| CST - Meshing |  |  |
| Achieving convergence of the electric field around the edges. |  | Rounded edges of the pads decreases ‘bleeding’ of tangential field components at metal surface.  Increasing mesh refinement at metal edge. |
| Low Quality Mesh Elements at the edges of the pads and the ground which are caused by low mesh density at places with large differences in element size. |  | Replace ground block (3D) with a sheet (2D). This eliminates the large differences in element size at the edge of the ground sheet. |
| Creating a fine initial mesh to decrease the amount of mesh refinement passes. | Give each component local meshing properties to increase quantity of mesh elements  Problem: Large number of unnecessary mesh elements which increases simulation time without improving results | Separate regions of interest (e.g. the edges of the pads) into different objects. This allows for the refinement of the mesh in (only) the region of interest, reducing the overall amount of mesh elements. |
| CST - Data |  |  |
| Find electric field on surfaces of interest. (MA, SA, MS interfaces) | Use CST’s existing post processing templates. Can only integrate and not which is needed to calculate the participation ratio. | Export data to MatLab and analyse data there. |
| Exporting tangential and normal components of the electric field separately. | Use export option within CST while selecting either normal or tangential components yields the same export file containing the entire electric field in x,y,z components | Nadia contacted CST (01-03), awaiting answer.  Work-around: Separate normal and tangential components using MatLab. This will only work when all faces are parallel to either x- ,y- or z-axis. (Angled DRIE won’t work) |
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