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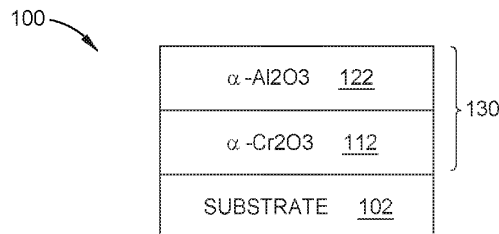


FIG. 1D

(57) Abstract: Embodiments of the present disclosure generally relate to protective coatings on substrates and methods for depositing the protective coatings. In one or more embodiments, a method of forming a protective coating on a substrate includes depositing a chromium oxide layer containing amorphous chromium oxide on a surface of the substrate during a first vapor deposition process and heating the substrate containing the chromium oxide layer comprising the amorphous chromium oxide to convert at least a portion of the amorphous chromium oxide to crystalline chromium oxide during a first annealing process. The method also includes depositing an aluminum oxide layer containing amorphous aluminum oxide on the chromium oxide layer during a second vapor deposition process and heating the substrate containing the aluminum oxide layer disposed on the chromium oxide layer to convert at least a portion of the amorphous aluminum oxide to crystalline aluminum oxide during a second annealing process.

[Continued on next page]

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