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(12) **United States Patent**  
**Saenger et al.**

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(54) **POLARIZATION-INFLUENCING OPTICAL ARRANGEMENT, IN PARTICULAR IN A MICROLITHOGRAPHIC PROJECTION EXPOSURE APPARATUS**

(58) **Field of Classification Search**  
CPC ..... G03F 7/70566; G03F 7/70966; G03F 7/70308  
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See application file for complete search history.

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(56) **References Cited**

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U.S. PATENT DOCUMENTS

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5,744,721 A 4/1998 Varnum  
5,886,810 A 3/1999 Siahpoushan et al.

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(Continued)

FOREIGN PATENT DOCUMENTS

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DE 101 24 566 11/2002  
DE 10 2007 027 985 A1 6/2008

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OTHER PUBLICATIONS

§ 371 (c)(1),  
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German Office Action with translation thereof, for corresponding DE Appln. No. 10 2012 200 368.1, dated Sep. 19, 2012.

(Continued)

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(57) **ABSTRACT**

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The disclosure provides a polarization-influencing optical arrangement that includes a first retardation element and a second retardation element. The optical arrangement is configurable so that a polarization-influencing effect of the first retardation element corresponds to an effect of a first lambda/2 plate having a first fast axis of the birefringence and a polarization-influencing effect of the second retardation element corresponds to an effect of a second lambda/2 plate having a second fast axis of the birefringence. An angle between the first fast axis and the second fast axis is 45°±5°.

(52) **U.S. Cl.**  
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**22 Claims, 9 Drawing Sheets**

