



Review

General trends of the carbon penetration in Si(001) surfaces: influences of relevant parameters

Philippe Sonnet ^{*}, Louise Stauffer

*Laboratoire de Physique et de Spectroscopie Electronique, CNRS-UMR 7014 – Université de Haute Alsace,
4, rue des frères Lumière, 68093 Mulhouse cedex, France*

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Abstract

Due to its importance in Si-based devices, carbon incorporation in a silicon matrix has become an object of intensive research. However, the size difference between carbon and silicon makes this incorporation difficult, and only small amounts of carbon (a few percent) can be introduced without giving rise to SiC precipitation. Experimental and theoretical studies combined together have led to important progress in the general understanding of surface–subsurface carbon incorporation in the clean and hydrogenated Si(001) reconstructed surfaces. These results emphasize the role of the surface reconstruction and the carbon–carbon interactions. However, the Si(001) surface often presents defects such as dimer vacancies or ad-dimers. By modifying the local stress, these defects can play an important role in carbon incorporation. We review the results of recent studies and discuss the role of different relevant parameters such as local stress, carbon–defect interactions, carbon concentration, position and orientation of the defects, defect–defect distance, defect concentration. . . Finally, we show how, acting on the surface defects, one might improve carbon penetration in Si(001) and allow a better control of the carbon position in the subsurface layers.

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^{*} Corresponding author. Tel.: +33 3 89 33 64 24.

E-mail address: philippe.sonnet@uha.fr (P. Sonnet).

Contents

| | | |
|--------|--|-----|
| 1. | Introduction | 445 |
| 2. | The carbonated Si(001) surface | 447 |
| 3. | Carbon incorporation in the defectless Si(001) surface. | 453 |
| 3.1. | Single carbon atom per unit cell ($n = 1$) | 454 |
| 3.2. | Two carbon atoms per unit cell ($n = 2$) | 454 |
| 3.3. | Four adsorbed carbon atoms per unit cell ($n = 4$) | 455 |
| 3.4. | Interaction energies | 456 |
| 3.5. | Conclusion and comparison with theoretical and experimental data. | 457 |
| 4. | Carbon incorporation in the hydrogenated Si(001) surface. | 459 |
| 4.1. | Single carbon atom per unit cell ($n = 1$) | 460 |
| 4.2. | Two carbon atoms per unit cell ($n = 2$) | 460 |
| 5. | Influence of some Si(001) defects on the carbon penetration | 462 |
| 6. | Effect of ad-dimers presence on the carbon incorporation | 462 |
| 6.1. | Ad-dimers on the non-carbonated Si(001) surface | 463 |
| 6.2. | Silicon and germanium ad-dimers on the carbonated Si(001) surface. | 464 |
| 6.2.1. | Single carbon atom per unit cell | 464 |
| 6.2.2. | Two carbon atoms per unit cell | 466 |
| 6.2.3. | Two silicon parallel ad-dimers per unit cell – single carbon incorporation | 468 |
| 6.2.4. | Conclusion | 468 |
| 6.3. | Influence of some relevant parameters in the carbon incorporation on Si(001) | 469 |
| 6.3.1. | Role of the surface reconstruction | 470 |
| 6.3.2. | Effect of the position of the carbon atom with respect to the surface | 470 |
| 6.3.3. | Position and orientation of the ad-dimer | 470 |
| 6.3.4. | Carbon–defect interaction | 470 |
| 6.3.5. | Local stress and size of the defect | 473 |
| 6.3.6. | Chemical nature of the defect | 473 |
| 7. | Increasing the number of carbon atoms or surface defects (ad-dimers) | 475 |
| 7.1. | Model | 475 |
| 7.2. | Increasing the number of Ge parAD's on Si(001) | 475 |
| 7.3. | Increasing the carbon coverage up to a carbon monolayer | 476 |
| 7.4. | Two possible ways of improving the carbon penetration in the Si(001) subsurface layers | 478 |
| 7.5. | “Distant” or “compact” parAD's – effect of the parAD–parAD distance | 478 |
| 7.6. | Effect of the ad-dimer location. | 478 |
| 7.7. | Influence of the local stress | 480 |
| 7.8. | Chemical nature of the defect. | 480 |
| 7.9. | Conclusion | 481 |
| 8. | Dimer vacancies. | 481 |
| 9. | Conclusion. | 483 |
| | Acknowledgements | 485 |
| | References | 486 |

1. Introduction

Carbon incorporation in a silicon matrix extends the range of electronic properties obtained using silicon alone, and opens exciting perspectives in the field of silicon-based

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