

CONTENTS TO PARTS A & B

CONTENTS TO PART A

Preface	vii
Section 1. Plenary session and program overviews	
1.1. <i>Materials pace new missions</i> , C.J. Blattner	3
1.2. <i>Relation of surface interactions to first-wall and in-vessel-component (IVC) design and materials performance in fusion devices</i> , R.W. Conn	7
1.3. <i>Blanket materials for DT fusion reactors</i> , D.L. Smith	19
1.4. <i>Materials issues in the fusion engineering device</i> , R.E. Nygren	31
1.5. <i>Important material considerations in INTOR</i> , M.A. Abdou, R.F. Mattas, D.L. Smith and G.L. Kulcinski	41
1.6. <i>Japanese program of materials research for fusion reactors</i> , R.R. Hasiguti	51
1.7. <i>The European programme on fusion materials</i> , J. Nihoul	57
1.8. <i>TASKA, a fusion engineering test facility for the 1990's</i> , G.L. Kulcinski, G.A. Emmert, C.W. Maynard, J.F. Santarius, M.E. Sawan, W. Heinz, P. Komarek, W. Maurer, A. Suppan and E.K. Opperman	67
Section 2. Structural applications and design	
2.1. <i>On materials problems of the first wall in INTOR</i> , P. Schiller	75
2.2. <i>Response of fusion reactor first walls to major plasma disruptions</i> , D.A. Bowers and J.R. Haines	81
2.3. <i>Materials handbook for fusion energy systems</i> , J.W. Davis and M.F. Marchbanks	87
2.4. <i>The influence of helium bubble migration on the creep rupture behavior of first wall materials under thermal transients</i> , D. Preininger and K. Ehrlich	91
2.5. <i>The effect of irradiation creep, swelling, wall erosion and embrittlement on the fatigue life of a Tokamak first wall</i> , R.D. Watson, R.R. Peterson and W.G. Wolfer	97
2.6. <i>The INPORT concept – an improved method to protect ICF reactor first walls</i> , G.L. Kulcinski, G.A. Moses, M. Sawan, I.N. Sviatoslavsky, D.K. Sze, W.F. Vogelsang and J. Sapp	103
2.7. <i>Production and behavior of point defects in pulsed inertial confinement fusion reactors</i> , M.E. Sawan, G.L. Kulcinski and N.M. Ghoniem	109
2.8. <i>Transient elastic stresses in ICF reactor first wall structural systems</i> , E.G. Lovell, R.R. Peterson, R.L. Engelstad and G.A. Moses	115
2.9. <i>A comparison of AISI type 316 and German type DIN 1.4970 stainless steel with regard to the first-wall lifetime</i> , W. Daenner	121
2.10. <i>Application of high strength copper alloys for a fusion reactor first wall</i> , O.K. Harling, G.P. Yu, N.J. Grant and J.E. Meyer	127
2.11. <i>Development and evaluation of some aluminum alloys as first wall materials for NET/INTOR</i> , G. Piatti, F. Brossa, P. Fiorini and G. Giordano	133
2.12. <i>A high manganese non-magnetic structural steel plate for the construction of fusion reactors</i> , S. Tone, M. Yamaga and Y. Kasamatsu	139
2.13. <i>Preliminary evaluation of beta-spodumene as a fusion reactor structural material</i> , P.V. Kelsey, Jr., R.E. Schmunk and S.P. Henslee	145

2.14. <i>An evaluation of the application of fracture mechanics procedures to fusion first wall structures</i> , G.R. Odette, R.O. Ritchie, P. McConnell and W. Server	149
2.15. <i>Dynamic response of fusion reactor components with temperature-dependent properties</i> , S.N. Singhal and E.G. Lovell	155
2.16. <i>Failure criteria for fusion reactor first wall structural design</i> , A.O. Adegbulugbe and J.E. Meyer	161
2.17. <i>Thermal stress in materials heated internally by radiation absorption</i> , J.R. Thomas, Jr., J.P. Singh and D.P.H. Hasselman	167
2.18. <i>Materials data base for fusion reactors-I</i> , S. Iwata, A. Nogami, S. Ishino, Y. Mishima, Y. Takao, T. Aruga and K. Shiraishi	173
Section 3. Limiters, divertors and coatings	
3.1. <i>Coated limiter testing in tokamaks</i> , J.B. Whitley, A.W. Mullendore, D.M. Mattox, P.W. Trester and L.C. Emerson	181
3.2. <i>Performance of TiC-coated graphite in electron beam tests and doublet III operation</i> , D.L. Sevier, P.W. Trester, G. Hopkins, T.E. McKelvey and T.S. Taylor	187
3.3. <i>Process evaluation and characterization of TiC coating on graphite for doublet III limiters and neutral beam armor</i> , P.W. Trester, D.L. Sevier, J. Chin, M.H. Horner, H.G. Staley and R. Kaplan	193
3.4. <i>Operational history of stainless steel, TiC, TiB₂, and boron limiters in the ISX-B tokamak</i> , L.C. Emerson, C.E. Bush, R.C. Isler, R.A. Langley, R.E. Clausing, M.J. Saltmarsh, J.B. Whitley and A.W. Mullendore	199
3.5. <i>Changes in near-surface microstructure of metallic limiters following one year of service in doublet III</i> , P.W. Trester, D.L. Sevier and M.M. Sabado	205
3.6. <i>Structured composite limiters for ablation control in fusion devices</i> , G. Hopkins, P. Trester and J. Whitley	211
3.7. <i>Materials selection for the U.S. INTOR divertor collector plate</i> , R.F. Mattas, B. Misra, D.L. Smith, G.D. Morgan, M. Delaney and R.E. Gold	217
3.8. <i>Material considerations for the fusion engineering device (FED) pump limiter</i> , J.R. Haines, B.A. Cramer, J.P. Davisson and H.C. Mantz	223
3.9. <i>Design considerations for a nonmagnetic divertor in an Elmo Bumpy Torus reactor</i> , D. Driemeyer, P. Stones, D. Bowers and R. Krakowski	229
3.10. <i>In-situ maintenance of low-Z limiters in reactors</i> , J.H. Norem and B.A. Cramer	235
3.11. <i>Self-sustaining thin films as a means of reducing first erosion and plasma impurity influx</i> , A.R. Krauss and D.M. Gruen	239
3.12. <i>Coating requirements for an ICF dry wall design</i> , L.H. Taylor and E.W. Sucov	245
3.13. <i>Thermal fatigue properties of coated materials for fusion device applications</i> , A.W. Mullendore, J.B. Whitley and D.M. Mattox	251
3.14. <i>Boron and doped boron first wall coatings by plasma CVD</i> , P. Groner, J.K. Gimzewski and S. Vepřek	257
3.15. <i>Tantalum protective coatings for fusion reactor applications</i> , F. Brossa, G. Piatti and M. Bardy	261
3.16. <i>Characterization of TiB₂ coated layer by X-ray lattice constant measurement</i> , I. Yoshizawa, R. Urao, Y. Hori, K. Akaishi and K. Kamada	267
3.17. <i>Preparation of titanium nitride onto molybdenum, stainless steel and carbon by gas absorption and reactive r.f. sputtering</i> , K. Sato, M. Mohri, T. Yamashina, and K. Yabe	273
3.18. <i>Plasma spray coating of low Z ceramics on molybdenum</i> , S. Morozumi, M. Kikuchi and S. Kanazawa	279
3.19. <i>Titanium carbide coatings on molybdenum by means of reactive sputtering and electron beam techniques</i> , T. Obata, H. Aida, Y. Hirohata, M. Mohri, T. Yamashina and K. Yabe	283
Section 4. Impurities, sputtering and blistering	
4.1. <i>Impurity generation</i> , J. Roth	291
4.2. <i>Temperature dependence of the erosion of Al and TiC by vacuum arcs in a magnetic field</i> , A.W. Nürnberg, D.Y. Fang, U.H. Bauder, R. Behrisch and F. Brossa	305
4.3. <i>High-speed photographic observation of plasma-limiter interactions in ISX-B</i> , R.E. Clausing, L.C. Emerson and L. Heatherly	309

4.4. <i>Effects of neutral beam injection and gas puffing on deuterium and impurity levels in the scrapeoff layer of ISX-B</i> , R.A. Zuhr, J.B. Roberto and S.P. Withrow	315
4.5. <i>Vaporization and melting of materials in fusion devices</i> , A.M. Hassanein, G.L. Kulcinski and W.G. Wolfer	321
4.6. <i>First wall evaporation in inertial confinement fusion reactors utilizing gas protection</i> , A.M. Hassanein, T.J. McCarville and G.L. Kulcinski	327
4.7. <i>The sputtering yield of typical impurity ions for different fusion reactor materials</i> , E. Hechtl, J. Bohdanský and J. Roth	333
4.8. <i>Light ion sputtering of fusion reactor materials in dependence of angle of incidence</i> , J. Bohdanský, G.L. Chen, W. Eckstein and J. Roth	339
4.9. <i>Sputtering yield calculations for neutral beam particle energies</i> , L.G. Haggmark and J.P. Biersack	345
4.10. <i>Energy analysis of secondary ion species sputtered from silicon carbide surface during deuterium ion irradiation</i> , S. Kato, T. Satake, M. Mohri and T. Yamashina	351
4.11. <i>ISS studies on sputtering of chemisorbed gases by low-energy ions</i> , A. Sagara, K. Akaishi, K. Kamada and A. Miyahara	357
4.12. <i>The behavior of boron coatings under simultaneous ion bombardment and temperature cycling</i> , H. Andresen, S.G. DiPietro, G. Kohse and O.K. Harling	363
✓ 4.13. <i>Sputtering and surface modification of TiC coatings by low energy deuterium bombardment</i> , J.A. Borders and G.C. Nelson	369
4.14. <i>Mechanism of initial processes of blistering in BCC metals</i> , N. Yoshida, E. Kuramoto and K. Kitajima	373
4.15. <i>Growth of lenticular bubbles in relation to blistering and flaking mechanism</i> , K. Kamada and Y. Higashida	379
4.16. <i>Near-surface stress effects on flaking and blistering of molybdenum</i> , W.J. Choyke, N.J. Doyle, J. Gregg and B.O. Hall	383
4.17. <i>Exposure and temperature dependence of elongated blister formation in complex radiation environments</i> , W.R. McDonell	387
4.18. <i>Helium irradiation of metallic glasses: sputtering and blistering properties</i> , B. Emmoth, M. Braun, T. Fried, J. Winter, F. Waelbroeck and P. Wienhold	393
4.19. <i>Suppression of repetitive surface exfoliation of Inconel 625 implanted sequentially with helium of different energies (20–100 keV)</i> , A.S. Rao, J.L. Whitton and M. Kaminsky	397
4.20. <i>Surface damage of CVD-SiC coatings on Mo under D⁺-irradiation</i> , M. Kitajima, M. Fukutomi and M. Okada	403
4.21. <i>Surface radiation damage in molybdenum alloys</i> , N. Igata and A. Kohyama	409
4.22. <i>Surface radiation damage in Mo-TiC eutectic alloy and TiC bombarded by Ar⁺ and He⁺ ions</i> , A. Kohyama and N. Igata	415
4.23. <i>Surface swelling produced in Nb and Ti-6 Al-4 V by He irradiation</i> , G. Veilleux and R.G. Saint-Jacques	421
4.24. <i>The structure of graphite and silicon carbide resulting from helium-ion bombardment</i> , D.J. Bacon, I. Dümmler and A.S. Rao	427
4.25. <i>Modifications of subsurface alloy composition during high-temperature sputtering</i> , N.Q. Lam and H. Wiedersich	433
4.26. <i>Surface modification of 300 series stainless steel by a deuterium plasma</i> , K.A. Kerst	439
4.27. <i>Surface roughness factor measurements of 304 and 316 stainless steels with helium ion irradiation</i> , S. Maeda, M. Mohri, M. Hashiba, T. Yamashina and M. Kaminsky	445
Section 5. Hydrogen recycling and hydrogen effects	
5.1. <i>Hydrogen recycling properties of stainless steels</i> , K.L. Wilson	453
5.2. <i>Effect of surface contamination and pretreatment on the hydrogen diffusion into and out of titanium under plasma conditions</i> , R.J. Brewer, J.K. Gimzewski, S. Vepřek and H. Stuessi	465
5.3. <i>Influence of the wall temperature on hydrogen recycling phenomena in an SS simulation apparatus</i> , F. Waelbroeck, J. Winter and P. Wienhold	471
5.4. <i>Absorption and desorption behavior of hydrogen by neutron irradiated titanium</i> , M. Miyake, Y. Hirooka, H. Shinmura, S. Yamanaka, T. Sano and Y. Higashiguchi	477
5.5. <i>Permeation and reemission of deuterium implanted in first wall materials</i> , T. Tanabe, N. Saito, Y. Etoh and S. Imoto	483
5.6. <i>Electron enhanced hydrogen attack on first wall materials</i> , C.I.H. Ashby and R.R. Rye	489
5.7. <i>Trapping of deuterium in helium-damaged steels: He⁺ fluence dependence</i> , K.L. Wilson, A.E. Pontau, L.G. Haggmark, M.I. Baskes, J. Bohdanský and J. Roth	493

5.8. <i>Ion impact desorption and hydrogen release</i> , R. Bastasz and L.G. Haggmark	499
5.9. <i>A trap activation model for hydrogen retention and isotope exchange in some refractory materials</i> , D.K. Brice and B.L. Doyle	503
5.10. <i>Depth resolved measurements of hydrogen isotope exchange in carbon</i> , W.R. Wampler and C.W. Magee	509
5.11. <i>Temperature dependence of H saturation and isotope exchange</i> , B.L. Doyle, W.R. Wampler and D.K. Brice	513
5.12. <i>Energy and angular dependences of low energy hydrogen ions backscattered from molybdenum, stainless steel and graphite</i> , A. Koma, K. Saiki, H. Tanaka and S. Tanaka	519
5.13. <i>The reflection of low energy helium atoms from tungsten surfaces</i> , M.T. Robinson	525
5.14. <i>Hydrogen recycling and impurities during isotopic exchange in ISX-B</i> , J.B. Roberto, R.C. Isler, S. Kasai, L.E. Murray, J.E. Simpkins, S.P. Withrow and R.A. Zuhr	531
5.15. <i>Regeneration of passive helium pumping</i> , A.E. Pontau, C.B. Layne and W. Bauer	535
5.16. <i>Compatibility of the Zr-Al alloy with a tokamak plasma environment</i> , R.J. Knize, J.L. Cecchi and H.F. Dylla	539

Section 6. Blanket and shield materials

6.1. <i>Solid breeder materials</i> , C.E. Johnson, R.G. Clemmer and G.W. Hollenberg	547
6.2. <i>Interactions of solid ceramic breeding materials with structural alloys</i> , O.K. Chopra and D.L. Smith	555
6.3. <i>Compatibility study of solid ceramic breeder materials</i> , P.A. Finn, S.R. Breon and N.R. Chellew	561
6.4. <i>Fusion reactor blanket and coolant material compatibility</i> , D.W. Jeppson and R.F. Keough	567
6.5. <i>Preparation, characterization, and chemistry of solid ceramic breeder materials</i> , R.M. Arons, R.B. Poeppel, M. Tetenbaum and C.E. Johnson	573
6.6. <i>Preparation of solid tritium breeding compounds for fusion reactors</i> , D.J. Suiter, J.W. Davis and B.A. Kirkpatrick	579
6.7. <i>Irradiation study of lithium compound samples for tritium breeding application</i> , L. Yang, R. Medico, W. Baugh and K. Schultz	585
6.8. <i>A transformation in lithium orthosilicate</i> , G.W. Hollenberg	591
6.9. <i>Thermal conductivity measurements of insulators for fusion blankets</i> , F.L. Horn, J.A. Fillo and J.R. Powell	597
6.10. <i>Impact of blanket and shield materials on cost of an EBT fusion power plant</i> , D.S. Zuckerman, L.M. Waganer, D.J. Dudziak and C.G. Bathke	603
6.11. <i>Material considerations in the Fusion Engineering Device (FED) bulk shield design</i> , J. Kirchner and B.A. Engholm	609
6.12. <i>Neutron-induced helium implantation in helium coolant pipes of fusion reactors</i> , H. Yamada	615

Section 7. Corrosion, compatibility and gettering in liquid lithium compounds

7.1. <i>Corrosion and compatibility considerations of liquid metals for fusion reactor applications</i> , P.F. Tortorelli and O.K. Chopra	621
7.2. <i>Effect of nickel concentration on the mass transfer of Fe-Ni-Cr alloys in lithium</i> , P.F. Tortorelli and J.H. DeVan	633
7.3. <i>A study of type 304 stainless steel containment tubing from a lithium test loop</i> , C. Bagnall	639
7.4. <i>Characterization of 304-SS and 316-SS exposed to liquid lithium for 10 000 hours</i> , H.R. Konvicka and P. Reithmayr	645
7.5. <i>Effects of lithium environment on the fatigue properties of ferritic and austenitic steels</i> , O.K. Chopra and D.L. Smith	651
7.6. <i>Corrosion inhibition experiments in liquid lithium</i> , G.C. Burrow, M.G. Down and C. Bagnall	657
7.7. <i>The influence of cyclic loading on the lithium corrosion behavior of reactor materials</i> , D.L. Hammon, G.J. Coubrough, D.K. Matlock and D.L. Olson	663
7.8. <i>The effect of lead concentration on the corrosion susceptibility of $2\frac{1}{4}$ Cr-1 Mo steel in a lead-lithium liquid</i> , B.D. Wilkinson, G.R. Edwards and N.J. Hoffman	669
7.9. <i>Corrosion of type 316 stainless steel in molten LiF-LiCl-LiBr</i> , P.F. Tortorelli, J.H. DeVan and J.R. Keiser	675
7.10. <i>Recent results on the gettering of tritium from molten lithium</i> , J.B. Talbot, P.W. Fisher and S.D. Clinton	681
7.11. <i>Thermodynamic stability of ceramic materials in liquid metals illustrated by beryllium compounds in liquid lithium</i> , H. Migge	687

7.12. <i>Material problems arising from impurity gettering of lithium by zirconium or titanium</i> , H.U. Borgstedt	693
7.13. <i>Influence of lithium exposure on the uniaxial tensile properties of a Cr–Mn austenitic stainless steel</i> , P. Fenici, V. Coen, E. Ruedle, H. Kolbe and T. Sasaki	699
Section 8. Materials for magnets and electrical applications	
8.1. <i>Ceramic and organic insulators for fusion applications</i> , F.W. Clinard, Jr. and G.F. Hurley	705
8.2. <i>Mechanical strength of low-temperature-irradiated polyimides: a five-to-tenfold improvement in dose-resistance over epoxies</i> , R.R. Coltman, Jr. and C.E. Klabunde	717
8.3. <i>Irradiation studies of magnet insulator materials</i> , R.E. Schmunk, G.R. Imel and Y.D. Harker	723
8.4. <i>Effect of low temperature irradiation on insulators and other materials for superconducting magnets</i> , S. Takamura and T. Kato	729
8.5. <i>Radiation damage in the copper stabilizer in a superconducting magnet</i> , R.E. Nygren	735
8.6. <i>Fusion neutron damage in superconductors and magnet stabilizers</i> , R.A. Van Konynenburg, M.W. Guinan and J.H. Kinney	739
8.7. <i>Neutron radiation damage in superconductor Nb₃Ge</i> , M.-H. Gély, F. Rullier-Albenque, Y. Quéré and A. Dunlop	745
8.8. <i>High-energy-neutron damage in Nb₃Sn: changes in critical properties, and damage-energy analysis</i> , C.L. Snead, Jr., D.M. Parkin and M.W. Guinan	749
8.9. <i>14 MeV neutron irradiation effects in macor glass-ceramic</i> , J.D. Fowler, Jr., G.F. Hurley, J.C. Kennedy and F.W. Clinard, Jr.	755
8.10. <i>Structural properties of MgO and MgAl₂O₄ after fission neutron irradiation near room temperature</i> , G.F. Hurley, J.C. Kennedy, F.W. Clinard, Jr., R.A. Youngman, and W.R. McDonell	761
8.11. <i>Neutron irradiation effects on SiO₂ and SiO₂-based glass ceramics</i> , D.L. Porter, M.R. Pascucci and B.H. Olbert	767
8.12. <i>Response of metallic glasses Fe₄₀Ni₄₀P₁₄B₆ and Fe₈₀B₂₀ to irradiation with 800 MeV protons</i> , J.R. Cost and W.F. Sommer	773
8.13. <i>Irradiation behavior of graphite probed by positrons</i> , M. Shimotomai, T. Takahashi, H. Fukishima, M. Doyama and T. Iwata	779
8.14. <i>Materials for vacuum seals and dielectric breaks in near term and commercial reactor designs</i> , G.W. Wille and C.A. Trachsel	783
8.15. <i>Radiation response of reaction-bonded and sintered SiC: effects of boron isotopes</i> , A.M. Carey, F.J. Pineau, C.W. Lee and J.C. Corelli	789